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IN THE

United States Circuit Court of Appeals
For the Ninth Circuit

BUTTE & SUPERIOR MINING COMPANY,
Appellant,

vs.

MINERALS SEPARATION, LTD., et al,
Appellees.

No. 3081

SUPPLEMENTAL BRIEF FOR APPELLEES.

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PARTIES, PLEADINGS AND PROCEEDINGS.

Parties. The appellees, plaintiffs below, are Minerals Separation, Ltd., a British corporation, the legal owner of the title to the patent in suit, Minerals Separation American Syndicate, Ltd., a British corporation, owner of a residual right to profits and damages for infringement up to October 10, 1913, and Mineral Separation North American Corporation, a domestic (Maryland) corporation, owner of the entire beneficial interest in the patent in suit and all rights to profits and damages other than the residual interest of Minerals Separation American Syndicate, Ltd. The appellant, defendant below, Butte & Superior Mining Company (formerly Butte & Superior Copper Company, Ltd), is an Arizona corporation having an established place of busi-

ness in Butte, Montana, where it has committed the acts of infringement complained of.

Proceedings Prior to Trial. Suit was commenced on October 10, 1913, with Minerals Separation, Ltd., as the sole plaintiff, and proceedings for a preliminary injunction immediately taken on an order to show cause issued October 11, 1913. This proceeding was heard on November 4, 5 and 6, 1913, and resulted in an opinion filed November 14, 1913, followed by an order entered November 14, 1913, denying preliminary injunction provided the defendant filed a bond in the sum of \$75,000, and stipulated not to enlarge its use of the process beyond its present facilities, and filed monthly verified statements setting out the operations of its oil flotation plant, in default whereof a preliminary injunction would issue upon the filing by plaintiff of a bond in the sum of \$125,000. This order was modified by a further order entered November 15, 1913. The defendant filed the bond and stipulation, and has filed monthly reports.

At the hearing on the motion for preliminary injunction the pleadings and proceedings in the suit of Minerals Separation, Ltd., and another against Hyde were offered in evidence in behalf of the plaintiff, and at the suggestion of the defendant were received in evidence for all purposes in all proceedings in the present suit. This appears in the Record (Vol. 5, p. 2206*) and was followed by a formal offer of evidence of that Record at the trial (pp. 2211, 2212). The Hyde Record in the

*The references in this brief will be to the printed Transcript of Record unless otherwise noted.

Unless otherwise noted, bracketed portions and italicizing in quotations will be ours.

District Court is reprinted in the present Record (Vols. 2, 3 and 4) including its index (Vol. 3, pp. 3-14). The mandate of the Supreme Court in the Hyde case is in evidence (Vol. 1, pp. cxi-cxiv) and the final decree thereon (pp. cxviii to cxx).

Pending the decision of the Supreme Court of the United States in the Hyde suit the plaintiff took depositions of witnesses proving infringement, these depositions being in evidence (Vol. 5, p. 2268) and printed at the beginning of Exhibit Volume 9.

On November 23, 1916, after the argument in, but before the decision of, the Supreme Court of the United States in the Hyde case, plaintiff petitioned the court below in the case at bar for an increase in security and other relief in view of the inadequacy of the bond as shown by the reports of the monthly operations of the defendant. When this petition was presented, defendant moved to vacate the order requiring monthly statements and to vacate the bond. Judge Bourquin decided that the opinion of this court in the Hyde case was the law of the Ninth Circuit, and denied plaintiff's petition and granted defendant's motion. His opinion is reported in 237 Fed. 401.

On January 13, 1917, after the decision of the Supreme Court in the Hyde case, the order for monthly statements and for the bond was reinstated by Judge Bourquin, and the time of trial assigned.

Pleadings. The bill of complaint was filed October 10, 1913 (printed, Vol. 1, pp. ii-viii).

The answer filed October 28, 1913 (printed, pp. xii-xxxii), sets up all of the defences of the Hyde suit and no other defences.

On March 27, 1917, about three weeks before the trial, the defendant filed a supplemental answer (printed pp. xxxiii-xli), setting up the decision of the Supreme Court holding claims 9, 10 and 11 of the patent in suit to be invalid, and averring that the plaintiff had unreasonably neglected and delayed the filing of a disclaimer, and that therefore the whole patent was void, and also averring that plaintiff was estopped from asserting that the patent was infringed by the use of an amount of oil exceeding five-tenths of one per cent. on the weight of the ore treated, by reason of certain statements made by counsel in the course of the argument of the Hyde case in the Supreme Court of the United States. It may be noted that the disclaimer happened to be executed in New York City on the day when this supplemental answer was filed in Butte and was filed in the Patent Office on the following day, March 28, 1917 (pp. cxv-cxvii).

On April 18, 1917, the second day of the trial, defendant filed an amendment to its answer (printed pp. lii-xlix) which in substance merely added the California Journal of Technology of November, 1903, as an alleged further anticipation of the patent in suit.

During the trial, on May 1, 1917, with leave of the court (Vol. 6, pp. 3436-3438) the plaintiffs filed a supplemental and amended bill of complaint (printed pp. lxxiv-lxxxiv), bringing in the additional parties Minerals

Separation American Syndicate, Ltd., and Minerals Separation North American Corporation, and pleading the disclaimer filed March 28, 1917, and charging continued infringement of claims 9, 10 and 11, as limited by said disclaimer, and of claims 1, 2, 3, 5, 6, 7 and 12 (pp. lxxviii-lxxix, par. 7). This supplemental and amended bill of complaint also pleaded the final decree in the Hyde suit and charged that the defendant in the present suit conducted and controlled the defence in the Hyde suit and was bound by the final decree in the Hyde suit. This latter contention was, however, abandoned by the plaintiffs at the close of the testimony (Vol. 8, pp. 4886, 4887), so that the present suit might be decided wholly on the merits.

Issue was joined on the supplemental and amended bill of complaint on May 4, 1917, by answer to the supplemental bill of complaint (Vol. 1, pp. cxxi-cxxxv) and by answer to bill of complaint as amended (pp. cxxxv-clxxvi).

Trial. The trial in open court commenced on April 16, 1917, and testimony was closed May 15, 1917, the twenty-fifth day of the trial. Oral arguments were presented at two extended sessions on May 16 and May 17. Thus the proceedings in court from beginning to end occupied twenty-seven days, practically five weeks. Additionally, however, the defendant gave an evening magic lantern exhibition of photographic slides in evidence, with explanations by Professor Taggart, on April 30, 1917 (Vol. 6, pp. 3411-3436). Additionally also the plaintiff exhibited the moving pictures in evidence to the court at an evening session on May 11, 1917, with

explanations appearing in full in the Record (Vol. 8, pp. 4538-4589). Further, on the afternoon of May 15, at the conclusion of the evidence, the court, on the invitation of the defendant, visited defendant's plant and inspected the operation of defendant's process there proceeding in the presence of plaintiffs' counsel and representatives, and on the same afternoon at the invitation of the plaintiffs visited the Timber-Butte mill, of a licensee of the plaintiffs, and inspected the plaintiffs' process there proceeding in the presence of defendant's counsel and representatives (Vol. 8, pp. 4887, 4888). Also during the trial numerous experiments, some fifty in all, were performed in illustration of the testimony, with material and products divided between the parties in open court for analysis and assay.

PRIOR ADJUDICATIONS.

In the opinion of the Circuit Court of Appeals for the Third Circuit in the suit of Minerals Separation, Ltd., one of the appellees herein, against Miami Copper Company (244 Fed. 752), the adjudications prior thereto are accurately tabulated (p. 754) as follows:

“British Ore Concentration Syndicate, Ltd., v. Minerals Separation, Ltd., 25 R. P. C., 741, High Court of Justice Chancery Division; affirmed after intermediate reversal in the Court of Appeals by the House of Lords in

Minerals Separation, Ltd., v. British Ore Concentration Syndicate, Ltd., 27 R. P. C., 33.

Ore Concentration Company, Ltd., v. Sulphide Corporation, Ltd., Supreme Court New South Wales, 31 R. P. C., 216, 217.

Ore Concentration Company, Ltd., v. Sulphide Corporation, 31 R. P. C., 206, Privy Council British Empire (printed in Supreme Court record in Hyde suit, pp. 747-757).

Minerals Separation, Ltd., v. Hyde, 207 Fed. 956 (D. C. Montana).

Hyde v. Minerals Separation, Ltd., 214 Fed. 100 (C. C. A., 9th Circuit).

Minerals Separation, Ltd., v. Hyde 242 U. S. 261.

Minerals Separation, Ltd., v. Miami Copper Co., 237 Fed. 609 (D. C. Delaware).''

Additionally on May 24, 1917, the opinion of the Circuit Court of Appeals for the Third Circuit above cited and quoted was filed. This opinion was by Judge Woolley and was concurred in by Judge McPherson. There was a dissenting opinion by Judge Buffington (244 Fed. 775-792), but the dissent was limited to the question of infringement of the first patent there in suit, the patent here in suit. As to the validity of the patent here in suit and as to the validity and infringement of two other patents there in suit, there was no dissent.

The present suit is the *fifth litigation* involving the process in suit. In the *first (British Ore Concentration Syndicate, Ltd. v. Minerals Separation, Ltd., finally decided by the House of Lords of Great Britain, on November 16, 1909)* Minerals Separation, Ltd., one of the appellees herein, was the defendant, and the alleged act of infringement was the use of the process in suit. The plaintiff was the owner of the Elmore British patents, corresponding to the Elmore patents in evidence herein, and the charge of infringement was finally limited to the second or A. S. Elmore patent correspond-

ing to U. S. patent No. 689,070 (printed Vol. 4, pp. 2093-2095). The trial court and the House of Lords decided that the use of the process in suit was not an infringement of this Elmore patent, and was a new method of separation.

The *second* suit, *Ore Concentration Co. Ltd. v. Sulphide Corporation Ltd.* was brought by the owners of the Elmore Australian patents against a licensee of the appellee, Minerals Separation, Ltd., and infringement was charged by the use of the process in suit. No appellee herein was a party to that suit. The trial "occupied thirty-one days" (31 R. P. C. 214) and the trial judge, Chief Judge in Equity Simpson, found again that the process in suit was a new method of procedure and did not infringe. Here also the charge of infringement was finally limited to the A. S. Elmore, or second Elmore patent. Appeal was taken directly to the Privy Council of the British Empire, with the consent of parties, and the Privy Council affirmed the trial court.

The *third* suit, *Minerals Separation v. Hyde*, started in the United States District Court of Montana, and was tried under the old equity practice. After final argument on pleadings and proofs Judge Bourquin decided that the patent in suit was valid and infringed. Appeal was taken to this court and the decree below reversed, on the ground that the invention was new only in degree and therefore unpatentable. The House of Lords judgment was referred to in the argument in this court. The Privy Council judgment was not rendered until March 6, 1914, after the argument of the Hyde case in

this court, although before the decision of this court. It was called to the attention of this court on petition for rehearing. This petition was denied, and a petition was thereafter presented to the Supreme Court of the United States for a writ of certiorari. This petition was granted, and the case was reviewed in the Supreme Court of the United States. The argument with extra allowance of time occurred on October 27, 30 and 31, 1916, and during the argument the Chief Justice announced a special informal session of the court between 10:30 and 12 in the forenoon of November 1, for demonstrations by the respective parties. These demonstrations were made in the court room and attended by all of the Justices, informally, occupying the floor of the court room and not the bench throughout the experiments. Thereafter, upon the commencement of the formal session of the court, at noon, the Chief Justice announced that an explanation of the experiments was desired, and that a further hour would be given to this, divided between the parties, one counsel for each party, upon the conclusion of the case then under argument. These explanations were given, and concluded the argument, which occupied in all seven and a half hours of the time of the court, during four days. The opinion of the court reversing the decree of this court and adjudicating the validity of the patent in suit and infringement thereof, was rendered on December 11, 1916, and is considered hereafter at length.

The *fourth* suit, that of *Minerals Separation Ltd. v. Miami Copper Company*, was commenced in the United

States District Court of Delaware. It was exhaustively tried in open court during the spring of 1915, the trial occupying nine weeks, and on September 29, 1916, Judge Bradford rendered the decision above cited adjudicating the validity and infringement of claims 1 and 12 of the patent here in suit, the invalidity of claim 9 of the patent here in suit, the validity and infringement of the second patent there in suit, known as the Soluble Frothing Agents patent, No. 962,678, Defendant's Exhibit 218 herein (printed Vol. 9, pp. 5274-5277) and invalidity of the third patent there in suit, not in evidence herein. Copies of this decision were handed to the Justices of the Supreme Court at the argument before that court of the Hyde case a month later.

Cross appeals were taken from Judge Bradford's decision in the Miami suit and were argued in the Circuit Court of Appeals for the Third Circuit at Philadelphia on January 30, 31, February 1, 2 and 3, 1917, occupying the entire time of the court for those five days. Plaintiff's appeal as to claim 9 of the patent here in suit was abandoned, as the Supreme Court had reached the same conclusion as Judge Bradford with respect to this claim. The Court of Appeals of the Third Circuit affirmed Judge Bradford as to validity and infringement of claims 1 and 12 of the patent here in suit, and as to validity and infringement of the Soluble Frothing Agents patent. They reversed Judge Bradford as to the third patent there in suit, adjudicating that patent to be valid and infringed. Their decision and the individual partial dissent of Judge Buffington, are considered later in this brief.

It will be noted that in all five suits the trial courts have adjudicated the novelty of the invention here in suit, and in the three suits based upon the patent here in suit, the validity and infringement of that patent. To like effect have been the adjudications of the three courts of absolutely last resort, the House of Lords of Great Britain, the Privy Council of the British Empire, and the Supreme Court of the United States, and the adjudication of the Circuit Court of Appeals for the Third Circuit, whose decision was not subject to appeal. In all nine courts have so decided, and five courts have specifically adjudicated the validity and infringement of the patent in suit.

It is of interest that in the Miami case the defendant obtained a stay on mandate for the purpose of preparing a petition to the Supreme Court of the United States for a writ of certiorari, and then gave notice of abandonment of its intention to petition for a review of the decree of that court, which, it is to be noted, was in all respects an interlocutory decree, referring the case to the court below for determination of profits and damages. The accounting in that case is now proceeding, and that is the only case except that at bar not finally concluded.

ORE CONCENTRATION PRIOR TO PATENT IN SUIT.

There is in the case at bar evidence additional to that in the Hyde suit, which very clearly sets forth the condition of the practical art of ore concentration as it existed prior to the invention in suit. This particu-

larly appears in the uncontradicted testimony of Professor Charles H. Fulton, a metallurgist of wide experience (Vol. 8, pp. 4388-4403).

Ore concentration as it existed prior to the patent in suit, and as it still exists where the invention in issue is not being used, is dependent upon the settlement in water of particles heavier than water but having a different rate of sinking power in water. At the date of the invention of the patent in suit, March, 1905, the mining world had nothing at its disposal for concentrating ores except this metal-sinking process, known as the water concentration process (Fulton, Vol. 8, p. 4390 et seq.; p. 4403, Q 10). The difficulty with this process is that sinking power is as much a function of size as it is of weight, so that although the metallic particles are heavier than the gangue particles, finely ground metallic particles will not sink with the larger metallic particles and will be carried away with the gangue (Fulton, pp. 4390-4392).

Metals are found in nature associated with rocky particles of worthless matter or gangue, the gangue forming the matrix in which the valuable metallic particles are held. The purpose of ore concentration is such a separation of the valuable metalliferous minerals from the worthless gangue as will produce a concentrate sufficiently rich in valuable mineral for the subsequent process of smelting, this being true as to the ores of copper, lead and zinc, and to some extent gold and silver. The metals zinc and lead are found in the form of sulphides having a metallic luster, copper is found in the form of metalliferous sulphides and sometimes pure

copper, and the same is true of silver and gold. These are the principal metals to which the process in suit is applicable.

It is common in the art to refer to the metal or metal-liferous mineral as the "mineral" and to the rocky material, sand, clay, etc., as "gangue." This terminology appears throughout the record, and to some extent in this brief.

The first essential of any treatment is the grinding of the ore, and this should be carried to such a point as to free the metallic particles from the gangue particles, to produce in fact wholly separate particles of metal and gangue. But every process of crushing or grinding, no matter how carefully manipulated, produces great quantities of extremely fine particles called slimes. The finer the grinding the greater the proportion of the slimes. *If the crushing is coarse, the metals and gangue are not separated and the metal is very apt to go away with the gangue. If the crushing is fine, the great amount of slimes produced will nearly all go away with the gangue.* This was the dilemma of the millman, and the slimes problem was so acute that coarse grinding was the rule. The metallic particles are usually much more brittle and friable than the gangue, so that the slimes were usually richer than the coarse particles.

Water Concentration. This process, above generally described, is the common process of ore concentration. It is in fact a process of washing the dirt or gangue away from the metal. It was the only process available to the mining world before the process of the pat-

ent in suit was invented, and is still in use where the process of the patent in suit is not in use.

Briefly it may be said that the water concentration process is carried on with a great amount of machinery—jigs with upward streams of water, and vanners, and shaking tables with streams of water flowing over them. The heavier metallic particles go to the bottom, while the lighter gangue particles, which do not sink so rapidly are flowed away in suspension by the water, and with them are flowed away the valuable metallic slimes. The great problem of the art preceding the invention in issue was the slimes problem, and that problem the invention in issue completely solved, since slimes are more readily concentrated by the invention in issue than coarser material and the presence of slimes seems to be essential for successful operations. It was quite usual in the prior art to deslime, that is to separate and throw away or dump the slimes, but whether they were separated and discarded before water concentration was attempted, or appeared in the tailings of water concentration, the result was the same, they were waste material rich in metal.

The evidence in the case at bar includes, additionally to that in the Hyde case, references to and quotations from the literature of the art as published just prior to the invention in suit, showing its attitude toward the problems which were solved by the invention in suit.

The “foremost authority of the world on ore dressing, Professor R. H. Richards” (Fulton, Vol. 8, p. 4393) in his standard text book on ore milling, “Richards on Ore Dressing,” published in 1903, just a little more than

a year before the birth of the invention of the patent in suit, gives us an excellent statement of this attitude of the art. From the extracts read from this standard work (pp. 4393-4400) it will be seen that the great problem of the art was the slimes problem, presenting to the millman the dilemma that if he ground too coarse he would not free the metal from the gangue, and if he ground reasonably fine he would lose great quantities of metal in the slimes which, by reason of the brittle character of the sulphide particles, were richer than the coarser material. In these quotations we find such statements as the following:

“Greasy flotation is a source of slime loss” (Vol. 8, p. 4396).

And, again:

“GREASINESS.—This is the term used to express the tendency of minerals to float on the surface of water as if they were greasy. It is caused by the aversion of the surface of the particle to become wetted. The particle may carry an air bubble down with it, which later floats it to the surface, or its dry surface may prevent its sinking at all, the particle floating at the base of a little dimple or depression on the surface of the water. This causes much trouble in ore dressing. * * * This property may be regarded rather as a difficulty to be overcome than as a help, for the reason that it cannot be depended upon—at one moment a given grain will float, at another it will sink” (Vol. 8, pp. 4396, 4397).

We also find the attitude of the art toward improvement as follows:

“TENDENCY AND FUTURE.—The tendency is distinctly toward graded crushing, graded sizing and graded washing” (pp. 4397, 4398).

That is to say, crush in several operations, deslime, and separate the crushed material into graded sizes, and wash it as thus graded. The following is the prophecy:

“The future progress to be made in ore dressing will probably be more in the development and perfection of the existing processes and machines than in the introduction of new processes. Not that new processes do not appear,—for they are brought out constantly,—but their disappearance is usually as sudden as their appearance” (p. 4398).

And this was in 1903. The engineers of the art looked for nothing better than improvements in water concentration methods, developments of the existing machines with slime losses minimized as much as possible. Greasy flotation was merely a source of trouble adding to the slime losses, and so uncertain as to be incapable of utilization.

Prior Oil Processes. In the book above referred to, a cyclopedic work on ore dressing, we should expect to find a reference to any departure from water concentration which had made the slightest impression on the art, and we do find here a reference to the Elmore oil-buoyancy flotation process (p. 4399) as a hope of the metallurgical art for those conditions where “there is only a slight difference in specific gravity between the mineral and gangue” (p. 4398). Nothing else that the defendant refers to is mentioned in this resume by Richards of the art of ore concentration almost contemporaneous with the birth of the invention of the patent in suit.

The Elmore oil-buoyancy flotation process required in its operation at least a ton of oil to a ton of ore, and lost about eight per cent. of the oil (Ballantyne, Vol. 2, pp. 358-361, Qs. 6, 7), the loss being about eighty times as much oil as is usually required in the process of the patent in suit. It reached the mill and failed (p. 360). It required coarse crushing and slimes were detrimental to the process (Liebmann, p. 557). It could not, therefore, solve the slimes problem.

The Cattermole metal-sinking process was the only other oil-using concentrating process that reached the mill. After elaborate preparatory investigation it was installed in Australia and operated for a few days only, then modified into an unsatisfactory hybrid film or skin flotation process (Chapman, pp. 245, 246, Qs. 22, 23), and then replaced by the process of the patent in suit (Q. 24). It depends upon the agglutination of the metal particles, including the metal slimes, by the cohesive-ness of oil coatings thereon, into larger granules which will reliably sink when treated by water concentration methods.

PATENT IN SUIT

This patent No. 835,120, was issued November 6, 1906, to Sulman, Picard and Ballot.

The process of the patent in suit is an air flotation process wherein, by the use of a frothing agent, and in the presence of such agitation as will maintain or produce distribution of the ore particles through the pulp and dissemination of bubbles of air through the pulp,

the air bubbles will seize the metallic particles and will carry them to and through the surface of the pulp, so as to permit of their delivery at or above the surface of the pulp separate from the gangue particles, which remain in suspension in the pulp or sink to the bottom.

The process of the patent in suit is the pioneer process of this character.

In it the frothing agent is an oil or immiscible or insoluble material. The discovery was that this mode of operation in the concentration of ores was attainable in the presence of oil. The process is not an oil flotation process, but is an air flotation process. The oil coats the metallic particles, modifies the water so as to produce or maintain minute and persistent air bubbles, and increases the attraction of the metallic particles for the air bubbles; and the persistency of the air bubbles and their attachment to the metallic particles are so great that the air bubbles carry the metallic particles to and through the surface of the pulp and when the air bubbles are exposed at or above the surface of the pulp, their oil-contaminated water films, carrying the metallic particles, are maintained intact until their separation from the body of the pulp has been effected, by overflowing or otherwise.

The air bubbles carrying the metallic particles form a floating mass of bubbles pressed against each other, frequently several inches in thickness, upon the surface of the pulp. Under quiescent conditions, this froth may float for days and weeks. A quiescent froth of this character has therefore been called a persistent or permanent froth. On the other hand the air bubbles which

carry the metallic particles may be continuously overflowed over a lip or dam, pressed upward by newly rising air bubbles, the froth being inflated if desired by excess of air bubbles. A wide range of opportunity is therefore afforded for the collection of the metallic particles selected and levitated by the air bubbles, and as the patent says, the froth may be "removed from the pulp by spitzkast, upcast, skimming, draining or otherwise" (Spec., p. 2, lines 1-3).

The patent fully and completely discloses the invention, and gives to the public the best knowledge possessed at the time of the filing of the patent application of the means for utilizing the invention, as abundantly appears in the record.

The important point as to discovery is truthfully stated to be that the inventors have found that a considerable reduction of oil from that required for the Cattermole granulation or metal-sinking process brings about the new process which the patent discloses and claims. The statement is as follows:

"We have found that if the proportion of oily substance be considerably reduced—say to a fraction of one per cent. on the ore—granulation ceases to take place, and after vigorous agitation there is a tendency for a part of the oil-coated metalliferous matter to rise to the surface of the pulp in the form of a froth or scum" (Spec., p. 1, lines 28-35).

This discovery is a historical fact, proved by three sets of contemporaneous documents, as well as by the testimony of the inventors and of the metallurgist who, under their direction, performed the experiments which led to and culminated in the discovery. This is here-

after particularly described under the heading "Discovery."

The Cattermole patents Nos. 777,273 and 777,274 are specifically referred to (Spec., p. 1, lines 16-27) in the preceding paragraph, and thus the reference to the Cattermole process is made definite and precise.

It will be noted that *a fraction of one per cent. is here stated in the specification by way of example*. A considerable reduction below the proportions of the Cattermole granulation or metal-sinking process is a considerable reduction below what is necessary in that particular instance to produce the Cattermole operation of adhesion of the mineral into granules that sink. This was, for example 5% on an ore having a 50% (or more) metalliferous mineral content, that being the standard in the only practical use that was ever made of the Cattermole process (Chapman, Vol. 2, p. 240, Q.9). This is 2½% or more of the ore, or 50 pounds of oil to the ton of ore. Again, in the laboratory at London, the Cattermole process was carried on with oil in the proportion of 1½% of the ore, and this is the smallest proportion that was ever used in the Cattermole process.

As to the Cattermole process patent No. 773,273, this patent suggests, as the Supreme Court says, "4% to 6% to 10% of the weight of the metalliferous mineral matter" (Opinion, p. 3*), insists upon a large metalliferous mineral content, and directs the user to

*The references in this brief to the Supreme Court opinion in the Hyde case will be to the pamphlet opinion as published by the Supreme Court.

determine by actual test and use the right amount of oil for carrying on its metal-sinking operation.

The various factors which contributed to the discovery are then briefly stated, to wit: acidification (Spec., p. 1, lines 36-45), this being stated as preferential "to render the selective action of the oil more marked" (Spec., p. 1, lines 43-44); and further it is stated that the process may be assisted if the pulp is warmed (Spec., p. 1, lines 51-56). Then comes a statement of great importance—of perhaps the most important advantage of the invention—as follows:

"The formation of froth is assisted by the fine pulverization of the ore, and we find that slime mineral most readily generates scum and rises to the surface while larger particles have less tendency to be included in the froth" (Spec., p. 1, lines 56-61).

Indeed the process will deal with slimes alone, a reject from all other processes heretofore or now in use, and take out the valuable mineral from pure slimes, as has been demonstrated by actual work in Australia and in the United States. Without this process slime production is the bane of the millman—the ruin of the mill. With it slime production is the rule of the millman—the salvation of the mill. Enormous losses of all other processes are saved. This subject was considered in the preceding chapters and necessarily appears more or less throughout the consideration of the invention in suit.

The factor of "fine pulverization of the ore" is illustrated in the specification by a specific example of the carrying on the process with a particular ore, to wit: Broken Hill ore of Australia, and it said that

“If the ore were crushed to ninety mesh to the linear inch (half of which ore will pass through one hundred and fifty mesh sieve)” (Spec., p. 1, lines 102-104).

the first froth obtained from a single agitation “may contain about seventy per cent. to eighty per cent. of the metalliferous matter present in the ore” (Spec., p. 1, line 105). This was an exact description of what took place in the tests made following the discovery of the new process. This was very fine crushing, finer than the prior art had dared to use, producing as stated a very large proportion, about fifty per cent. of what was practically slimes. As testified to by Mr. Higgins, the ores treated in 1905 were generally crushed to 30 or 40 mesh, and it was doubted whether the profits of the operation would sustain the cost of crushing to 90 mesh (Vol. 8, pp. 4535, 4536, Q.362). This recommendation of very fine crushing was therefore put forward cautiously.

In processes of ore concentration of wide application, a great variety of different ores has been and will be encountered. This fact is generally recognized by all familiar with mining operations. Each ore to some extent presents its own problem to the engineer. As the Supreme Court of the United States says in the Hyde case:

“The composition of ores varies infinitely, each one presenting its special problem, and it is obviously impossible to specify in a patent the precise treatment which would be most successful and economical in each case. The process is one for dealing with a large class of substances and the range of treatment within the terms of the claims, while leaving something to the skill of persons applying the invention, is clearly sufficiently definite to guide those skilled in the art to its successful

application, as the evidence abundantly shows. This satisfies the law'' (242 U. S., p. 261, pamphlet opinion p. 7).

And as the District Court said in the same case:

"It is true every ore presents its own problem of reduction. So, while all may lend themselves to a general method, each may require some modification of the method. All skilled in the art understand this and know that in addition to the best scientific theory they must add the light given by trial and practice. Thus only, in the majority of cases, are good and the best results obtained in any ore reduction—smelting, milling or concentration'' (207 Fed. 961).

The statement in the specification is as follows:

"The proportion of mineral which floats in the form of froth varies considerably with different ores and with different oily substances, and before utilizing the facts above mentioned in the concentration of any particular ore a simple preliminary test is necessary to determine *which oily substance* yields the proportion of froth or scum desired'' (Spec., p. 1, lines 61-69).

Mr. Chapman in the Hyde case (Vol. 2, pp. 263-265, Q. 51) well described the simple preliminary tests which are being made every day in the laboratories of the appellees. The determination of the conditions best adapted for the treatment of any ore, and "which oily substance" will do the work, is a simple metallurgical operation.

Thus the specification directed the appellant to test its ore for the purpose of determining a suitable oily substance and the proportions in which it should be used to give the best results of the process.

The first operations of the appellant followed exactly the directions of the specification with the use of the

oil oleic acid, which is the example of the specification, in the proportion of .16% of the ore (3.2 lbs. per ton of ore) as proved in the Hyde suit for the operations of August, 1911 (Chandler, Vol. 2, p. 166, Q. 15). Later another froth-producing oil, pine oil, was mixed with the oleic acid in a total proportion of .14% (2.79 lbs. per ton of ore). This began in September, 1913 (Dosenbach, Vol. 6, pp. 3442, 3443, XQs. 436-440). Experience demonstrated that pine oil could be used alone, and this became the standard practice commencing about December, 1914, with pine oil in the proportion of .18%, or 1.64 lbs. per ton of ore (p. 3444, Qs. 449, 450). During the years 1915 and 1916 pine oil alone was the standard practice until December 22, 1916 (Q. 452) and the appellant's table of operations shows that for the years 1915 and 1916 oil was used in the proportion of .07% (Vol. 9, pp. 5184, 5185). The process of the patent in suit was then used at greatest advantage and with the best results ever attained by the appellant. The directions of the specification of the patent in suit had been explicitly followed. But on December 11, 1916, the Supreme Court of the United States decided that all of these operations were infringements of the patent in suit, and the appellant cast about for some means of continuing to use the invention and yet evading the patent. A mixture of oils was finally produced containing 70% of fuel oil, 12% of kerosene and 18% of pine oil (Dosenbach, Vol. 6, pp. 3344, 3345, Qs. 136, 137), and it was found that this mixture could be used in a total proportion either slightly under 1%, and therefore a fraction of one per cent., or at 1% and

therefore not a fraction of one per cent., and even slightly above 1%. At 1% the proportion of pine oil is .18% of the ore, and the proportion of the petroleum oils, fuel oil and kerosene, is .82% of the ore. The fact that these petroleum oils were not such oily substances as would do the work, could have been and probably was verified by appellant by simple tests such as Mr. Higgins performed at the trial (Vol. 8, pp. 4603-4614). Therefore according to the disclosure of the specification (held by the Supreme Court to be a sufficient disclosure) the oily substance which was then added to the froth-producing oil was not an oily substance which would carry on the process of the patent in suit with the appellant's ore. It was therefore not the oil of the specification or the oil of the claims of the patent in suit, but mere extraneous material no more entering into the process described and claimed than any other extraneous material which did not happen to be an oil or an oily substance. It may be noted that the increase in the froth-producing oil from .07%, the proportion of 1915 and 1916, to .18%, the proportion used in the petroleum-containing mixture, was a slight increase in the amount of froth-producing^{oil}, evidently to mitigate to some extent the deleterious effects of the useless material poured into the pulp.

The specification next gives the example of the application of the invention to the concentration of Broken Hill ore, with the use of a particular oily frothing agent, to wit, oleic acid. The statement in the specification is as follows:

“The following is an example of the application of this invention to the concentration of a particular ore” (Spec., p. 1, lines 70-73).

This description is well summarized by defendant's expert in the Hyde suit, Dr. Byrnes, as follows:

“The patent then proceeds with a detailed description of the treatment of a particular ore, containing ferruginous blende, zinc sulphide carrying iron; galena, lead sulphide; and gangue consisting of quartz, rhodonite and garnet, silica or silicates containing no metalliferous values” (Vol. 4, pp. 1456, 1457).

This example is the well known ore of Broken Hill, Australia (Liebmann, Vol. 3, p. 709), which is the ore upon which the process was first tried and first used in practice.

This example of the application of the process with oleic acid to Broken Hill ore is described as conducted in “a cone mixer or the like as in the processes previously cited” (Spec., p. 1, lines 83-85).

The processes previously cited are those disclosed in the two Cattermole patents referred to earlier in the specification (Spec., p. 1, lines 16-27). The “cone mixer” is the so-called Gabbett shown and described in Gabbett U. S. patent No. 444,345 of January 6, 1891, and the form of Gabbett used was that shown in Figure 9 of that patent (Vol. 3, p. 1227), with omission of the inner ribs A¹ of the rotating cone A, all as appears in the physical exhibit in the Hyde suit Complainant's Exhibit Cone Mixer, identified by Mr. Higgins as a reproduction of the original apparatus used by him in March, 1905 (Vol. 3, pp. 925, 926, Qs 23, 24).

The specification says that the ore pulp containing oil

“is briskly agitated in a cone mixer or the like, as in the processes previously cited, for about two and one-half to ten minutes, until the oleic acid has been brought into efficient contact with all the mineral particles in the pulp” (Spec., p. 1, lines 83-88).

Brisk agitation such as characterized the Cattermole process (in the identical apparatus and at exactly the same speed) effected abundant aeration of the pulp. In the Cattermole process the *Gabbett was speeded up—its “speed was very much increased”* over what had been used in prior uses of the Gabbett—and in fact Cattermole *introduced high speed agitation into the metallurgical art* (Higgins, Vol. 8, pp. 4533, 4534, Qs 351-354). Even appellant’s expert Sadtler admits that especially violent agitation was a characteristic of the Cattermole process (Vol. 7, p. 3605, Qs 173, 174). This high speed of agitation, at about 900 revolutions per minute (Vol. 8, pp. 4534, 4535, Q358) produced abundant aeration which was of no utility in the Cattermole process and no hindrance when the granules were properly made (Qs354-357). The cone revolving at this speed of 900 revolutions per minute operated to produce a vortex in the center of the revolving pulp, this vortex drawing in air from above and introducing it into the pulp near the bottom of the body of the pulp so that the actual operation was subaeration of the pulp, although the air came from above. The process in suit was carried on at the time of its discovery in the Cattermole apparatus and with the Cattermole

speed of operation, 900 revolutions per minute (Higgins, pp. 4534, 4535, Q58).

The specification then says:

“When agitation is stopped, a large proportion of the mineral present rises to the surface in the form of a froth or scum which has derived its power of flotation mainly from the inclusion of air bubbles introduced into the mass by the agitation, such bubbles or air-films adhering only to the mineral particles which are coated with oleic acid” (Spec., p. 1, lines 89-96).

Here we have described the production of a metal-carrying air-froth resulting from the introduction into and inclusion in the pulp of *air bubbles adhering to the mineral particles coated with oil*, i. e., resulting from the oil-modified air-lift which follows such agitation as characterized the Cattermole process.

The amount of oil described in this specific example is

“a very small proportion of oleic acid, say from 0.02 per cent. to 0.5 per cent. on the weight of the ore” (Spec., p. 1, lines 80-82).

and the recommendation as to this specific example is

“the minimum amount of oleic acid which can be used to effect the flotation of the mineral in the form of froth may be under 0.1% of the ore; but this proportion has been found suitable and economical” (Spec., p. 1, lines 96-101).

Thus for Broken Hill ore, with oleic acid as the oil, and in the presence of a small proportion of “a mineral acid or acid salt” (Spec., p. 1, line 77) and with pulp warmed “say to 30° to 40° Centigrade” (Spec., p. 1, lines 82, 83), the proportion of oleic acid recommended

is "0.1% of the ore" (Spec., p. 1, lines 99, 100), and the limits suggested are say from 0.02% to 0.5% on the weight of ore" (Spec., p. 1, lines 80-82). Any attempt to ascribe to this language a limitation of the invention, in all its applications to all ores, to .5% on the ore as the maximum quantity, is wholly unjustified. The disclosure of the invention is given

"in such full, clear, concise and exact terms as to enable any person skilled in the art or science to which it appertains * * * to * * * use the same" (U. S. R. S., Sec. 4888),

as has been adjudged by the Supreme Court of the United States. The inventors have performed their duty by filing such a description in their specification. It is not within the bounds of reason that having done so as to one application of their invention, they are to be limited by the details of that description as to every application of their invention. And so the Supreme Court expressly said in the opinion in the Hyde suit (p. 7).

The description of the operation is concluded by a statement as to the removal of the froth. The specification says:

"This froth is removed from the pulp by spitzkast, upcast, skimming, draining, or otherwise" (Spec., p. 2, lines 1-3).

This completes a disclosure of an operation embodying the invention, and had the specification stopped here, the invention would have been completely disclosed. Professor Chandler, in his explanation of the invention as disclosed in the specification, stops at this point (Vol.

2, pp. 136-143, Q4). For the purpose of the Hyde suit, no further explanation was necessary.

The patent further describes, however, a complete apparatus for continuous operation, with one Gabbett or several Gabbetts in series and a series of spitzkasten acting both for froth separation and for classification of the tailings. This apparatus is diagrammatically shown in Figure 1 of the patent and is specifically described. It is a continuously acting apparatus, whereas the single Gabbett without spitzkasten first described is necessarily an intermittent apparatus. This continuously acting apparatus need not be considered in detail, however, since classification of the tailings is not an essential part of the process, although used to some extent today in connection with the process.

Two other disclosures of the patent, as to the method of introducing air and the kind and degree of agitation, become of special interest in the present suit because here the appellant uses two forms of apparatus employing compressed air discharged into the pulp through a porous medium, for both agitation and aeration. These disclosures will now be considered.

Froth-flotation by air bubbles liberated in the pulp. One of these disclosures is of what is known as the supraeration modification. It was tersely explained by defendant's expert Dr. Brynes in the Hyde case as follows:

"In the modified apparatus shown in Figure 2 of the drawing, the oiled and agitated pulp from the cone mixer is passed through a discharge-conduit a^1 pipe a^2 , pump e and pipe e^1 , into a closed chamber f , wherein it is first subjected to an atmosphere of air or other gas compressed

to from 50 to 100 pounds per square inch, for a few minutes, being thence discharged to the froth-separator with three chambers heretofore described. The air or gas dissolved under pressure and evolved upon discharge from the compression-vessel, assisting the aeration produced in the cone agitator, is said to cause all of the oiled mineral to rise to the surface as a single froth, obviating the necessity of retreating the tailings, as with the first apparatus illustrated" (Vol. 4, p. 1460).

This is almost a fair description of this modified procedure disclosed in the patent in suit, wherein the pulp is subjected to air or other gas pressure so as to effect the solution of the air or gas in the pulp (thereby also largely dissolving the air bubbles that were produced by agitation) and the pressure is thereafter relieved, whereupon air or gas bubbles are liberated from solution throughout the pulp and

"at once sweep to the surface thereof all of the metal-liferous matter in the form of a froth" (Spec., p. 2, lines 113-115).

This modification is first described as an alternative method for the recovery of metal from the finer tailings which settle in the second and third spitzkasten of the three spitzkasten shown in Figure 1 of the patent in suit (Spec., p. 2, lines 103-116); alternative to "*further treatment by agitation*" (Spec., p. 2, lines 86, 87), as to the "medium sands" which sink in the second spitzkasten J² (Spec., p. 2, lines 84, 85), and alternative to discharge "to waste or further treatment" (Spec., p. 2, lines 91, 92), as to the "fine sands or gangue slimes" (Spec., p. 2, line 90), which settle in the last spitzkasten J³. This part of the description is referred to by appellant's expert Dr. Sadtler as

“the introduction of air without the violent agitation”
(Vol. 5, p. 2819, Q79).

although he overlooks the later description of this air bubble liberation method as a complete modified process of froth formation and separation, commencing with crushed ore and circuit water fed into a Gabbett and ending with the separation of the froth by overflowing (Spec., p. 2, line 120, p. 3, line 34).

In connection with the first mentioned of these descriptions there is a disclaimer in the following language:

“This idea is not claimed broadly in this case, but forms the subject matter of an application filed by us on January 9, 1906, Serial Number 295,326” (Spec., p. 2, lines 116-119).

The idea thus disclaimed is the broad idea of air or gas bubble introduction into an ore pulp by solution of the air or gas therein at high pressure, and liberation from solution throughout the pulp by relief from the high pressure. This broad idea is capable of use in film flotation with or without oil, and in froth flotation, with or without oil, and the patent in suit is only concerned with its use in froth flotation with oil, which is one specific application of this broad idea. All of the uses of this broad idea are covered in the supraaeration patent No. 835,479, which was issued simultaneously with the patent in suit on November 6, 1906 (Vol. 4, pp. 2172-2174), on the aforesaid application filed January 9, 1906, Ser. No. 295,326 as a division of (i.e., containing matter withdrawn from or divided out of) the

application for the patent in suit. The broad claim of that patent is as follows:

“1. The process of separating powdered minerals from one another which consists in suspending the powdered minerals in a liquid, subjecting the mixture to a gas pressure, and thereafter relieving the pressure whereby bubbles of gas are liberated in the pulp and carry certain minerals to the surface” (Vol. 4, p. 2174).

This is a very broad claim and any use of supraaeration in froth flotation with an oily reagent would be dominated by it. Likewise any other use of supraaeration in flotation of minerals would be dominated by it. The disclosure of supraaeration in the patent in suit is therefore a specific application of the broad supraaeration invention claimed in patent No. 835,479. To that extent the patent in suit discloses a specific application of supraaeration. In fact it discloses two specific applications of supraaeration, one as a supplement to the process as carried on in the apparatus shown in Figure 1 of the patent in suit, and the other either as a substitute for the procedure carried on in the apparatus of Figure 1 of the patent in suit, or as a substitute for the first disclosure of the procedure in the single Gabbett. Both disclosures are of froth flotation, and both are within and are covered by the claims of the patent in suit. The disclaimer of the broad supraaeration invention and the reference to the companion application are therefore appropriate, properly informative to the public, and might have been necessary to prevent abandonment of the broad invention of supraaeration if it had happened that the patent in suit issued first and the supraaeration patent issued on a

later day. It happened that the two patents issued on the same day and the information of the public was complete on that day.

Thus froth flotation with supraeration is covered by the claims of the patent in suit and is also more broadly covered by the claims of the supraeration patent No. 835,479. On the other hand froth flotation without supraeration, or any other procedure without supraeration, would not be covered by this patent No. 835,479. We have here an excellent example of the familiar fact in patent law that patented inventions may under certain conditions overlap and under other conditions be independently applied. The disclaimer in the patent in suit is therefore a proper disclaimer, exactly fitting the facts, and properly notifying the public that they are to seek in another patent the broad claims for supraeration, although its uses in the two specific applications disclosed in the patent in suit are given as examples of modified procedures within the claims of the patent in suit. Obviously the purpose of the inventors in including these modified disclosures in the specification of the patent in suit was to furnish additional examples of the application of the invention patented by the patent in suit; and this is particularly true as to the description of the procedure in the apparatus shown in Figure 2, since this procedure is described as a complete substitute for the entire procedures earlier described in the specification, and can have no purpose in the specification other than as a description of a modified procedure embodying the invention claimed in the patent in suit.

Oil-coating with gentle agitation. The other disclosure which now becomes of interest, is of a modification in the method of disseminating the oil through the pulp and coating the mineral with oil. The specification of the patent in suit says:

“If desired, the oleic acid used in the first instance may be produced *in situ* in the pulp by decomposing a dilute soap solution with mineral acid, as described in the previous patent, No. 777,274, cited above” (Spec., p. 2, lines 9-13).

The patent here referred to is the Cattermole, Sulman & Picard patent known as the soap and granulation patent, also referred to earlier in the specification of the patent in suit (Spec., p. 1, lines 23-27). In this patent No. 777,274 (printed Vol. 4, pp. 2141, 2142), we find a full description of a procedure which obviates the necessity of employing agitation to bring the particles of oil in contact with the metallic particles and to cause the metallic particles to be coated with films of oil. This description is as follows:

“In carrying out our invention the suitably-crushed ore is suspended in water, and to the mixture an addition of a small quantity of soap solution is made. A small amount of mineral acid is then added, which decomposes the soluble soap or other similar compound by uniting with the alkaline base thereof, thus liberating in a state of chemical subdivision the fatty or resin acid or other compound, such as cresol, &c., in intimate contact with the suspended ore particles. It is found that the liberated acids [*such as the oil oleic acid*] &c., which may even be solid under ordinary conditions, are precipitated and adhere to the sulphureted minerals or to sulphur, graphite, or free metals present in the ore, leaving the gangue or earthy particles preferentially wet by water and free from adhesions of fatty acid and the like. The fatty acid and

the like used for the purpose of adhering to the mineral particles is thus produced *in situ* throughout the suspended ore mass in the most intimate contact or admixture therewith, and the mineral particles become attached to or more or less coated by films of fatty or resin acid" (Vol. 4, p. 2141, lines 32-56).

In the specification of this patent No. 777,274 there is no mention whatsoever of agitation. Concededly a certain amount of gentle stirring would be advisable for uniform distribution throughout the water of the "soluble soap" added in the form of "soap solution," such for example as is required to uniformly distribute the milk which has been added to a cup of coffee, and similarly a gentle stirring for distributing the acid through the thin solution of soluble soap in water, but this is merely the commingling of miscible liquids. Beyond that no agitation is required for coating the mineral particles with oil.

With the employment of this suggested modification of procedure, the employment of brisk agitation for the purpose of bringing the oleic acid

"into efficient contact with all the mineral particles in the pulp" (Spec. pat. in suit, p. 1, lines 87, 88).

becomes no longer necessary and the problem of froth concentration resolves itself simply into one of producing modified air-bubbles in the pulp and bringing these air bubbles into contact with the oiled metallic particles. Obviously any apparatus that aerates effectively and brings the air bubbles into contact with the oiled metallic particles and results in the production and separation of a froth concentrate, will carry on the process. The language of Judge Bradford in *Minerals*

Separation Ltd. v. Miami Copper Co. (237 Fed. 631-633) is here particularly apt. He considers very fully the defendant's use of a Callow cell pneumatic aerator and agitator and the disclosures of the patent in suit as to agitation in a Gabbett and then says:

"The strength of agitation referred to in the description clearly admits of different degrees, varying from one another in the application of the process to different ores and under changing conditions. There is no room for doubt that agitation of the mixture in the process of the defendant is sufficiently vigorous or brisk to insure efficient ore concentration by an air flotation process such as is accomplished by the complainant by agitation under the process of the first patent in suit. This being true the use of mere adjectives in the descriptive portion of the patent with respect to agitation is unimportant. In order that the bubbles in the pulp mixture may come in contact with the metallic particles there must be such movement between them as cannot be wholly accounted for by selectivity as between them, and their movement, so far as not accounted for by selectivity, is the result of agitation; and whether such agitation results from the stirring or beating of the mixture or the forcing or admission of air into it is immaterial; for what this court is dealing with is not an apparatus patent, but a process patent."

Apparatus of Figure 1. As to the continuous procedure carried on in the apparatus of Figure 1 of the patent in suit, it may be noted that this specific three-spitzkasten tailings-classifier was designed for treating the coarse crushed material which the inventors actually used and it to some extent indicates their fear that the fine crushing which they recommend in the patent might not be generally accepted by the art (Higgins, Vol. 8, p. 4535, Q362). The specification says:

"The formation of froth is assisted by the fine pulverization of the ore, and we find that slime mineral most

readily generates scum and rises to the surface, while the larger particles have less tendency to be included in the froth'' (Spec., p. 1, lines 56-61).

The specification also says:

''The metalliferous matter which did not form part of the froth (generally the larger particles) remains in admixture with the gangue in the pulp'' (Spec., p. 2, lines 25-28).

The tailings-classifying function of the spitzkasten arrangement shown is well described by Mr. Higgins (Vol. 8, pp. 4535-4537, Qs360-368). The arrangement was devised for dealing with coarse crushed ores. In practice finer crushing, such as recommended in the patent, proved practicable, and first the up-currents were discontinued (Sulman, Vol. 4, p. 1611, Q28) and later the apparatus was reduced to a single spitzkasten for each froth separation, as in the Minerals Separation standard machine (Vol. 3, pp. 1306-1308). Indeed, the art is now chiefly concerned with crushing the ore to extreme fineness, 100 and 150 mesh, and the invention of the process in suit has wholly changed the procedure of the art in this respect (Higgins, Vol. 8, p. 4537, Q369).

It is to be noted also that the classification (separation into material of different sizes) of material treated by the process in suit, is still used, as, for example, all the middlings of the Utah Arthur plant are put through a classifier to assure that only the finest material returns to treatment by the process (Janney, Vol. 5, pp. 2550, 2551; Vol. 7, p. 3826).

Among the recommendations of the patent in suit for further treatment to separate the metalliferous matter not recovered in the froth is “*further treatment by agitation*” (Spec., p. 2, lines 86, 87). This recommendation of the patent in suit has been followed in the development of the new art which the invention of the patent in suit created as well as the recommendation of very fine grinding, and today flotation-concentration is characterized by these two dominating factors, *fine grinding and repeated agitation and aeration*.

That an invention such as that in suit, of a new process or art, is not to be limited to the particular apparatus in which it is carried out by the inventors, is a proposition of patent law ~~is~~ fundamental in character. The Telephone cases (126 U. S. 1, 533) illustrate the determining principles. Here Mr. Chief Justice Waite said (p. 533):

“The patent for the art does not necessarily involve a patent for the particular means employed for using it. Indeed, the mention of any means, in the specification or descriptive portion of the patent, is only necessary to show that the art can be used; for it is only useful arts—arts which may be used to advantage that can be made the subject of a patent. The language of the statute is that ‘any person who has invented or discovered any new and useful art, machine, manufacture, or composition of matter,’ may obtain a patent therefor. Rev. Stat., Sec. 4886. Thus, an art—a process—which is useful is as much the subject of a patent, as a machine, manufacture, or composition of matter. Of this there can be no doubt, and it is abundantly supported by authority. *Corning v. Burden*, 56 U. S., 15 How. 252, 267; *Cochrane v. Deener*, 94 U. S. 780, 787, 788; *Tilghman v. Proctor*, 102 U. S. 708, 722, 724, 725; *New Process Fermentation Co. v. Maus*, 122 U. S. 413.”

The specification makes the intendment of the patentees quite clear in its closing statement, as follows:

“The nature and arrangement of the apparatus used may be varied without departing from this invention” (Spec. p. 3, lines 35-37).

Further, the specification describes Figure 1 as

“illustrating one form of apparatus suitable for carrying this invention into practice” (Spec., p. 2, lines 47-49).

CLAIMS ADJUDGED VALID BY THE SUPREME COURT.

The claims in issue are 1, 2, 3, 5, 6, 7, 9, 10, 11 and 12, as pleaded in the original bill of complaint (p. iv, paragraph VI) and in the supplemental bill of complaint (p. lxxviii, paragraph 7). They are the same claims that were in issue in the Hyde case, the charge of infringement in that case having been thus limited by notice on the record (Vol. 2, p. 168). The only change that has occurred in these claims has been the limitation of claims 9, 10 and 11 by disclaimer, to be hereinafter considered. The claims in issue are analytically stated by Professor Chandler and are also analyzed by him (Vol. 2, pp. 143-147). Claim 1 is as follows:

“1. The herein-described process of concentrating ores which consists in mixing the powdered ore with water, adding a small proportion of an oily liquid having a preferential affinity for metalliferous matter (amounting to a fraction of one per cent. on the ore), agitating the mixture until the oil-coated mineral matter forms into a froth, and separating the froth from the remainder by flotation.”

According to the process pointed out in this claim powdered ore and water are commingled to form an ore pulp, a small proportion of an oily liquid, amounting to a fraction of one per cent. on the ore, is added to the pulp, and the mixture is agitated until the oil-coated metalliferous particles form into a froth, and this froth is separated from the remainder by flotation. This process as disclosed in the patent may be carried on intermittently as first disclosed in the patent, in a single Gabbett, by adding the charge, briskly agitating it, stopping the agitation to allow the liquid to come to rest and the air bubbles and attached mineral particles to rise to and through the surface of the liquid and to form a froth floating thereon, and removing the froth by skimming, draining, or overflowing, or by flowing the agitated pulp into a "spitzkast, upcast" (Spec., p. 2, line 2) or otherwise. It may be carried on continuously, as disclosed in the patent, by continuously feeding the ore pulp and oil to an agitating vessel or a series of agitating vessels, continuously flowing out the contents into a separating vessel or vessels, continuously overflowing the froth therefrom and continuously flowing out the residue or tailings from the bottom of the separating vessel or vessels, with classification of these tailings in separate spitzkasten if desired. Also, as disclosed in the patent, air bubbles may be liberated in the pulp to attach themselves to the oiled metallic particles and sweep them to the surface to form the froth, as by superaeration. Also, as disclosed in the patent, the oil may be liberated *in situ* completely disseminated throughout the ore pulp, by introduction in

the form of soluble soap and precipitation by acid, obviating the necessity of other than the most gentle agitation for the purpose of disseminating the oil through the pulp. *The breadth of the disclosure is commensurate with the breadth of the claim.* In the Hyde case the defendant copied the exact methods of the plaintiffs and there was no occasion to consider the supraeration and soluble soap modifications. In the Miami case the defendant used a Callow cell, with agitation by aeration, as the separating vessel, and also used preliminary agitators which both agitated and aerated the pulp. In the Hyde case and in the Miami case the defendants used the proportions of oil specified in this claim. In the present case the appellant from 1911 until the end of 1916 did just what Hyde did. Since then it has at times managed to increase the total amount of oil used to something a little larger than a fraction of one per cent. of oil on the ore but has not succeeded in increasing the mineral-froth-producing oil to anything more than a small fraction of one per cent.

Claim 2 differs from claim 1 in that it adds to what is pointed out in claim 1 that the water shall be "slightly acidified," and the appellant here has always slightly acidified his pulp.

Claim 3 adds to what is pointed out in claim 2 that the mixture shall be warmed. It therefore specifies both acidification and heating. The appellant has used both until recently.

Claim 5 differs from claim 1 only in that the oily liquid is stated to be oleic acid in the proportion of

.02% to .5% on the ore. This claim was only infringed by those procedures of the appellant wherein oleic acid was used, which terminated in 1914. It is an oleic acid claim and therefore its upper limit of .5% on the ore is a limitation restricted in its application to a process employing oleic acid as the oil.

Claim 6 differs from claim 2 in the same respect as claim 5 differs from claim 1, i. e., it adds acidification to what is included in claim 5; and was infringed up to the end of 1914.

Claim 7 differs from claim 3 in the same respects, and also adds the statement that the warming shall be to 30° to 40° Centigrade, i. e., it adds acidification and heating of a specific character to what is included in claim 5. This also is an oleic acid claim and was infringed up to the end of 1914.

Claims 9, 10 and 11 have been limited by the disclaimer and will be next considered.

Claim 12 is the broadest claim wherein it is stated that the oil is a fraction of one per cent. on the ore. The agitation described in this claim is stated to be for the purpose of causing "the oil-coated mineral to form a froth" and the *method of "coating the minerals with oil" is not specified*. If for example diluted soft soap solution were used as the pulp liquor and oleic acid precipitated by sulphuric acid from the pulp liquor and thereby the minerals coated with oil with only gentle agitation, the language of this claim would directly apply even should it be held that the language

of claim 1 did not apply. It has at all times been infringed by the appellant.

DISCLAIMER.

The disclaimer was filed March 28, 1917, following the mandate whereby the decree of the Supreme Court became effective, issued on January 13, 1917. The time taken for consideration of this action was about seventy days, allowing for mail transmission, and was remarkably short when one considers the magnitude of the questions involved in this disclaimer, and the fact that counsel during this period argued the appeal in the Miami case, prepared and filed reply briefs therein, and then prepared for the trial of the present suit, and that the patentees resided abroad and that mail communication abroad was uncertain and greatly delayed by the war.

The Supreme Court did not, as courts often do, direct the filing of a disclaimer. The burden was cast upon parties and counsel of deciding all the momentous questions involved.

After careful examination and consideration of the law and the facts the present disclaimer was filed. It follows exactly the opinion of the Supreme Court, using the identical words of the crucial part of that opinion expressing the views of that court as to the manner in which "the patent must be confined."

The Supreme Court said that the patent in suit was valid as to claims 1, 2, 3, 5, 6, 7 and 12 and infringed

as to those claims, but invalid as to claims 9, 10 and 11 (claims 4, 8 and 13 being stated to be not in issue).

The decree in both its aspects was made expressly as a consequence of the holding that

“the patent must be confined to the results obtained by the use of oil within the proportions often described in the testimony and in the claims of the patent as ‘critical proportions’ ‘amounting to a fraction of one per cent. on the ore’ ”.

No other reason is given for decreeing the patent invalid as to claims 9, 10 and 11.

We must therefore conclude that in the judgment of the Supreme Court claims 9, 10 and 11 were not

“confined to the results obtained by the use of oil within the proportions”

specified.

The mandate of the Supreme Court was issued on January 13, 1917, and was filed in the U. S. District Court for the District of Montana on March 5, 1917 (p. cxi).

Thereupon, and on the 28th day of March, 1917, and many months before appellees’ right to petition the Supreme Court for a rehearing (as to claims 9, 10 and 11) and defendant’s right to petition for a rehearing (as to the other claims in issue) had expired, Minerals Separation Ltd., one of the appellees here, and the sole owner, then and now, of the letters patent in suit, filed its disclaimer,

“disclaiming those parts of the thing patented which your petitioner does not choose to claim or hold by virtue of said Letters Patent No. 835,120, does hereby disclaim from

claims 9, 10 and 11 of said Letters Patent No. 835,120, any process of concentrating powdered ores excepting where the results obtained are the results obtained by the use of oil in a quantity amounting to a fraction of one per cent. on the ore" (p. cxv-cxvii; cxxii-cxxxiv).

This disclaimer, in purpose and in terms, cut off, and excluded, from the subject matter of claims 9, 10 and 11, all the excess, whatever it might be, that was included within those claims over and above what the Supreme Court had said the patent must be confined to; and in legal effect, therefore, it confined claims 9, 10 and 11 to the subject matter to which the Supreme Court had said the patent must be confined.

On its face the disclaimer refers to the Supreme Court decision in the Hyde case as advising Minerals Separation, Ltd., of the infirmity of the patent, in so far as concerns claims 9, 10 and 11, and so it must be interpreted in the light of that decision. And in its disclaiming part it employs the very words of the decision.

Whatever the overplus found by the Supreme Court to be within the inclusion of claims 9, 10 and 11 was, that overplus is disclaimed by the disclaimer, and nothing more is disclaimed, and the disclaimer therefore leaves claims 9, 10 and 11 "confined" (as claims 1, 2, 3, 5, 6, 7 and 12 of the patent were found to be already 'confined' without any disclaimer)

"to the results obtained by the use of oil within the proportions often described in the testimony and in the claims of the patent as 'critical proportions' 'amounting to a fraction of one per cent. on the ore' "

The overplus in claims 9, 10 and 11 must have been distinguishable to the Supreme Court, for its presence constituted the basis of the holding of invalidity as to claims 9, 10 and 11; and what is left after the disclaiming of that overplus must have been equally distinguishable to the Supreme Court, for it constituted the basis of the holding of validity of claims 1, 2, 3, 5, 6, 7 and 12.

Appellees in their supplementary and amended bill of complaint filed May 1, 1917 (p. lxxiv-cxx), pleaded the filing of the disclaimer (par. 5, p. lxxvii), the consequent validity of claims 9, 10 and 11 as limited by that disclaimer, and that the appellant had infringed same (par. 7, p. lxxvii) and prayed for an injunction and an accounting as to same (p. lxxxii).

Appellant filed an answer to the supplemental bill of complaint on May 4, 1917 (pp. cxx-cxxiv) in which and especially in paragraphs V (p. cxxiii) and X (p. cxxvixix), it pleaded that the disclaimer was in effect and in law no disclaimer at all, and in any event that it had been filed too late, that is to say, not without unreasonable neglect and delay, and that the patent in suit is in consequence invalid and void not only as to claims 9, 10 and 11 but also as to claims 1, 2, 3, 5, 6, 7 and 12, and all other claims.

Appellant's brief does not contend as was vigorously contended in the court below that the disclaimer was filed too late, but only that it is not a disclaimer and therefore no disclaimer has been filed and that it is now too late to file a disclaimer. We do not concede that it is now too late to file a disclaimer, but the argu-

ment is now limited to the question whether the disclaimer was a proper disclaimer under the statutes.

All questions arising under the disclaimer were fully argued in the court below on April 16, 1917, the first day of the trial, on objection made to the offering of the disclaimer in evidence (Vol. 5, pp. 2212-2263) and were decided by the court in an opinion found at pages 2263 to 2267, the court overruling the objections.

The disclaimer questions were argued again at the end of the trial but the court below did not disturb its decision and entered a decree holding the patent in suit good and valid in law as to claims 1, 2, 3, 5, 6, 7 and 12 and as to claims 9, 10 and 11 as limited by disclaimer, and infringement of same, and for an injunction and accounting.

THE DISCLAIMER WAS A PROPER DISCLAIMER UNDER THE STATUTES.

The statutes in question are Sections 4917 and 4922, U. S. R. S.

Those statutes prescribe that whenever without fraud a patentee has *claimed* more than that of which he was the original and first inventor or discoverer, his patent will be valid (Section 4917), and he may maintain an infringement suit at law or in equity (Section 4922), as to any or all of that part which is truly and justly his own, if it is a material and substantial part of the thing patented and definitely distinguishable from the parts claimed without right, provided such patentee, his executors, administrators, heirs or assigns make disclaimer

without unreasonable neglect or delay of such parts of the thing patented as he shall not choose to claim or hold by virtue of the patent.

In the case at bar no fraud in originally making claims 9, 10 and 11 is alleged or proved. The Supreme Court in the Hyde case held that in and by claims 9, 10 and 11 the patentees had claimed more than that of which they were the original and first inventors or discoverers. The Supreme Court at the same time held that the patentees had made an invention of importance, and defined it, and by necessary implication held that that invention was definitely distinguishable from the parts claimed in claims 9, 10 and 11 without right. For claims 1, 2, 3, 5, 6, 7 and 12 were upheld as valid and infringed in the same breath in which claims 9, 10 and 11 were held invalid, and in both cases because it was held that the patent must be confined "to the results obtained by the use of oil within the proportions often described in the testimony and in the claims of the patent as 'critical proportions' 'amounting to a fraction of one per cent. on the ore.' "

Claims 9, 10 and 11 were held invalid because broader in scope than the actual invention. They covered and included the process that constitutes the actual invention but they also covered and included processes that were not the actual invention. The disclaimer disclaims that overplus, that excess over and above the real invention, and disclaims the whole of that overplus or excess. The disclaimer prunes down the claims to a scope no broader than the real invention. Claims 9, 10 and 11, without the disclaimer would have been infringed by

one who made use of the real invention. They would also have been infringed by one who employed other and different processes—for so the Supreme Court has held. Claims 9, 10 and 11 as limited by the disclaimer would be infringed by one who used the real invention, but they would not be infringed otherwise. The disclaimer has therefore cured those claims of the patent from the vice of claiming more than that of which the patentees were the original and first inventors or discoverers.

Nothing has been added by the disclaimer to the description or to the claims or to the breadth or scope of the claims. As to the description nothing has been changed or altered—not a word or an implication. As to the claims (9, 10 and 11) they have merely been narrowed in scope to eliminate from them, and with the legal effect of eliminating from them, the extra breadth or scope or overplus of scope that caused the Supreme Court to hold them invalid.

This limitation of the scope of a claim by cutting off so much of its inclusion as extends it out beyond the confines of the real invention is the very purpose and idea of a disclaimer under the law and the practice.

Claims 9, 10 and 11 were held invalid by the Supreme Court, not because they would not be infringed by the practice of the real invention of the patentees, but because they might also be infringed by the practice of processes and procedures that would not embody the real invention in that those processes obtained results different from those obtained by the use of oil in a quantity amounting to a fraction of one per cent. on the

ore. Those claims since the date of filing of the disclaimer do not cover or include any processes or procedures except one within their terms where the results obtained are those obtained by the use of oil in a quantity amounting to a fraction of one per cent. on the ore.

Thus claim 9, since the entering of the disclaimer, is, in contemplation of law, only for the process of concentrating powdered ores, which consists in separating the mineral from the gangue by coating the mineral with oil in water containing a small quantity of oil, agitating the mixture to form a froth, and separating the froth, where the results obtained are those obtained by the use of oil in a quantity amounting to a fraction of one per cent. on the ore.

Similarly claim 10 is for that process where the mixture is warmed; and claim 11 is for that process when there is added a quantity of acid insufficient to cause chemical action on the metalliferous minerals present.

Illustrations of similar disclaimers upheld as valid and effectual under the law are numerous. In *Carnegie Steel Co. v. Cambria Co.*, 185 U. S. 403,

“the disclaimer was not of a claim, but of certain statements in the specification, which if retained, might be construed to have the effect of illegally broadening the second claim”.

In that case, apparently, the claim was susceptible either of an illegally broad or of a legally narrow construction, and the court allowed as a proper and valid disclaimer the disclaimer of certain statements in the specification that might have imported an illegal breadth

into the claim. All the more clearly within the statute is the case at bar, where the illegal broadening of the claim is found not in any statement of the specification but in the language of the claim itself. If a disclaimer of any illegal broadening of a claim implied from a statement in the specification is within the statute, much more is a disclaimer of an illegal broadening of a claim expressed on its face, for the latter is what the statutes expressly and explicitly address themselves to.

In the case under citation the Supreme Court remarked:

“As we had occasion to observe in *Sessions v. Romadka*, 145 U. S. 29, ‘the power to disclaim is a beneficial one, and ought not to be denied except where it is resorted to for a fraudulent and deceptive purpose’ ”.

The Supreme Court cites *Hurlbut v. Schillinger*, 130 U. S., 456; *Schillinger v. Gunther*, 17 Blatch., Fed. Cases No. 12458; *Schwartzwalder v. N. Y. Filter Co.*, 66 Fed. 152.

In *Silsby v. Foote*, 14 Howard 218, 221, the claim was for the application of a certain automatic damper control for a stove “or other structure.” It was shown that the same automatic control was old to regulate the heat of other structures than a stove. Thereupon the patentee entered a disclaimer,

“to so much of said claim as extends the application of the expansive and contracting power of a metallic rod by different degrees of heat to any other use or purpose than that of regulating the heat of a stove in which such rod shall be acted upon directly by the heat of the stove or the fire which it contains”.

The Supreme Court sustained the disclaimer.

In *Tuck v. Bramhill*, 6 Blatch., 95, 24 Fed. Cas., 259, the claim was for a packing for pistons of a certain construction, "with or without a core." After testimony had been taken showing the structure old without the core, plaintiff filed a disclaimer "to that part of the claim which covers the packing therein described without a core," thereby limiting the claim to the peculiar packing recited when employed with a core, and the validity of that disclaimer was at issue. The court said

"it having been shown that the forming of the roll in the manner described, without the core, was old, the next question is whether the plaintiff could disclaim, as he has attempted to do, the forming of the roll without the core, and so limit the claim to forming of the roll with the core".

The court upheld the disclaimer as valid.

In the *Electrical Accumulator Co. v. Julien Co.*, 38 Fed., 117, the claim was for an electrode of a secondary battery coated with a certain active layer by galvanic action or chemical precipitation or otherwise. The specification had described the application of the active layer mechanically in the form of a paint, paste or cement, and also its application by galvanic deposition, and also its application by chemical precipitation. The court found that the real invention was the application of the active material mechanically in the form of a paint, paste or cement. The court also found that it was old to apply the active material mechanically in the form of a dry powder. The court suggested that the claim might be limited by disclaimer to the real invention,

and plaintiff subsequently filed a disclaimer of any and every way of coating an electrode with an active layer in which the active layer was wholly applied otherwise than in the form of a paint, paste or cement practically insoluble in the electrolytic liquid, and the disclaimer was upheld as valid. Incidentally the disclaimer cut out certain phrases from the specification descriptive of other ways of coating an electrode than by mechanically applying in the form of a paint, paste or cement.

In *Thompson v. Bushnell*, 96 Fed. 238, a patent was involved which had been held invalid or not infringed in *Thompson v. Jennings* (66 Fed. 57; on appeal 75 Fed. 572) where the Circuit Court of Appeals had intimated that the patent could be sustained only if limited to hack saws and band saws. On this suggestion the owners of the patent filed a disclaimer in the Patent Office "of so much of said claims as covers circular saws and back saws, leaving said claims to include only hack saws and band saws." The Circuit Court of Appeals sustained this disclaimer. The court said:

"The phraseology of the claims, however, read in connection with the specification, was broad enough to cover all four varieties of the class known as 'metal saws', although as to two of them it was useful, and as to the other two useless. Certainly there was an actual, separable invention. In view of the fact that the four varieties of this class of saw were well known to the trade and their difference clearly recognized, as the evidence shows, no amended specification or supplemental description is required to make the new claim intelligible, and a disclaimer of circular and back saws leaves the patent in force as to the other varieties of the class."

The defendant argued that the disclaimer was not a proper one, the theory being that there was no separate

invention in its application to different kinds of saws, and that a restriction of the claim to any one kind of saw was practically adding to the claim a new element, to wit: the kind of mounting, different kinds of saws being distinguished from each other only by their particular kind of mounting. But the court held to the contrary.

In *Schwartzwalder v. N. Y. Filter Co.*, 66 Fed. 152, a disclaimer was upheld which struck out from the specification certain broadening language which made the claim by construction too broad, in view of the state of the art. In that case the disclaimer was of a recital in the specification that had been intended to enlarge the scope of the claim. The court said:

“The disclaimer consequently operates only to expunge from the claim what otherwise would, by force of the recital, be incorporated into it constructively. * * * The patent, after the disclaimers, is to be read exactly as though the recital had never been inserted.”

It was urged by the defendant that the defense of want of novelty should be tested by the original terms and scope of the claim, but the court said:

“We are aware of no principle which permits a patent to be defeated for want of novelty in respect to the subject matter which has been eliminated from it by a disclaimer. The office of the disclaimer is to enable a patentee to save himself from the peril of such a defense. Matters which have been properly disclaimed cease to be a part of the invention, and, as was said by the Supreme Court in *Dunbar v. Myers*, 94 U. S. 104: ‘It follows that the construction of the patent must be the same as it would be if such matter had never been included in the description of the invention or the claims of the specification.’ ”

In *Simplex Co. v. Pressed Steel Car Co.*, 189 Fed. 70, the Circuit Court of Appeals for the Second Circuit sustained a disclaimer to a part of the specification which said

“that, though the best results are obtained by keeping the tension member straight, if the construction be varied by bending the tension member and keeping compression member straight it will still be within the spirit of the invention”.

The effect of the disclaimer was held to be to limit the patent to a bolster having a straight tension member and a compression member with its end bent. The court said:

“The effect of the disclaimer was not to broaden the claim, but to limit it to the construction described and shown, of a straight tension member and a bent compression member. Until this disclaimer was allowed it was possible to contend for a construction of claim 6 broad enough to include a structure described in the language disclaimed, viz., a straight compression member and a bent tension member. That this was a proper case for a disclaimer and that the language disclaimed is no longer a part of the specification, are propositions which are sustained by the following authorities: *Dunbar v. Myers*, 94 U. S. 187; 24 L. Ed. 34, and cases cited in *Accumulator Co. v. Julien Co.* (C. C.), 38 Fed. 117, 133-136.”

In *Libbey v. Mt. Washington Glass Co.*, 26 Fed. 757, Judge Colt said:

“The claims of the patent are as broad as the specification, and are not limited to any particular compound. Since bringing suit, the plaintiff had filed a disclaimer under the statute, in which he limits his claim to the gold-ruby compound. This the plaintiff had a right to do. Under the authorities cited by the plaintiff, this was a patent where a part could be properly disclaimed. It

did not require the importation of anything new in the specification, but simply the elimination of a part of what was originally claimed. A disclaimer can be made after suit is commenced.”

In *Marconi Wireless v. De Forest*, 243 Fed. 560, the Circuit Court of Appeals for the Second Circuit sustained a disclaimer similar to that in the case at bar. In that case the claims in suit were as follows:

“1. The combination of a vacuous vessel, two conductors adjacent to, but not touching each other in the vessel, means for heating one of the conductors, and a circuit outside the vessel connecting the two conductors.”

“37. At a receiving station in a system of wireless telegraphy employing electrical oscillations of high frequency, a detector comprising a vacuous vessel, two conductors adjacent to, but not touching, each other in the vessel, means for heating one of the conductors, a circuit outside of the vessel connecting the two conductors, means for detecting a continuous current in the circuit, and means for impressing upon the circuit the received oscillations.”

After action begun, plaintiff entered a disclaimer “to the combination of elements set forth in claim 1, * * * except as the same are used in connection with high-frequency alternating electric currents or electric oscillations of the order employed in Hertzian wave transmission,” and also to certain words of the specification referring to low frequency currents.

The court said (p. 565):

“The contention that Fleming’s patent, whatever its original merit or lack thereof, was voided by an unlawful disclaimer, is without substance. The mistake (if there was one) was in claiming something not needed, and the disclaimer abandoned what was not wanted, without broadening or enlarging any claim; it also left the claims

fully supported by the original specification. No injury to defendant, or any one else, is shown. The procedure is within *Carnegie Steel Co. v. Cambria Iron Co.*, 185 U. S. 403; 22 Sup. Ct. 698; 46 L. Ed. 968, and our former decisions in *Simplex etc. Co. v. Pressed Steel Co.*, 189 Fed. 70; 110 C. C. A. 634, and *Strause etc. Co. v. Crane Co.*, 235 Fed. at page 129; 148 C. C. A. 620."

In *Page v. Dow*, 200 Fed. 72, Judge Hazel sustained as valid a disclaimer which practically changed the words "constantly acting source of power" in a combination claim into the words "constantly rotating drive shaft."

The court said:

"The defendant insists that the disclaimer changes the character of the invention and substitutes a different element, but I am persuaded by the proofs to the contrary. To substitute the words 'constantly rotating drive shaft' for the words 'constantly acting source of power' did not, in my opinion, alter or change the invention; nor was it the addition of an equivalent element for one that had been abandoned. The effect of the disclaimer was merely to limit the original claim, which was thought too broad, to a constantly rotating drive shaft actuated by a constantly rotating motor. Disclaimers of this description, when filed within a reasonable time of the discovery that a disclaimer is necessary, have many times received the approval of the Federal courts." See authorities cited.

For a most excellent discussion of the whole law of disclaimer see *Suddard v. American Motor Car Co.*, 163 Fed. 852.

Under these and other similar authorities that might be cited, it appears that in the case of a claim that is too broad, broader than the real invention, or that is ambiguous and so may be construed more broadly than the

real invention, the patentee may disclaim the excess over and above what he has invented and make his patent in that way, and to that extent, specific and definite and free from ambiguity.

There is nothing in the authorities or in the Statute, or in reason, that would require the patentee to give up and disclaim the whole of claims 9, 10 and 11, for that would be to disclaim the part which he has invented and to which he is justly entitled, as well as the excess over and above that part. By disclaiming the excess he retains only that part to which he is entitled. There is nothing in the law which would require him to give up the portion of these claims to which he is entitled. The law does not require that an entire claim be disclaimed, but only the excess over and above what has been invented.

The statutes provide a remedy by re-issue (Section 4916) whenever a patent is inoperative or invalid by reason of a defective or insufficient specification, or by reason of the patentee claiming as his own invention or discovery more than he had a right to claim as new. The remedy by disclaimer applies also to a case where the patent is invalid by reason of the patentee claiming as his own invention or discovery more than he had a right to claim as new. The remedy by disclaimer is proper where the part that is left was truly and justly the patentee's invention and was a material and substantial part of the thing patented and is definitely distinguishable from the parts claimed without right. In such a case the remedy apparently might be either by

disclaimer or by re-issue. Where, however, there is any change or alteration *in the specification* (other than mere excision of specific statement) the remedy cannot be disclaimer and must be by re-issue. In other words, if the specification is defective or insufficient in any respect the remedy must be by re-issue. For example, if the claim is narrower than the real invention, the patent is regarded as inoperative and the specification as defective or insufficient for the purpose of covering the real invention, and in such case the only remedy is by re-issue. This broadening of the claim out to the limits of the real invention has been the usual purpose of re-issuing and such re-issues have been upheld where they have not changed or altered the invention and have been promptly applied for. A re-issue to narrow the scope of a claim is unusual except where some change has coincidentally to be made in the specification or new claims are to be added. Where nothing but diminution of claim is sought and the part left is definitely distinguishable from the part claimed without right, there the remedy by disclaimer is appropriate and effectual. This matter is discussed in many of the cases cited and in others. See *Carnegie Steel Co. v. Cambria Co.*, 185 U. S. 403. In that case the court through Mr. Justice Brown said:

“Had the purpose of the disclaimer been to reform or alter the description of the invention, or convert the claim from one thing into something else, it might have been objectionable, as patents can only be amended for mistakes of this kind by re-issue. But the disclaimer in this case appears to have been made to obviate an ambiguity in the specification, and with no idea of obtaining the benefits of a re-issue. If the [disclaimed] clauses had the effect of broadening the patent the disclaimer removes

the objection. If they did not, the disclaimer could do no harm, and cannot be made the subject of criticism.”

In the case at bar the disclaimer has no purpose or effect to reform or alter the description of the invention, or to convert the claim from one thing into something else. But it has been made to remove from the scope and purview of claims 9, 10 and 11 all that part which in the judgment of the Supreme Court was claimed there without right, and so to obviate the objection to the patent that it claimed more than the patentee had the right to claim as new.

CLAIMS VALIDATED BY DISCLAIMER.

Claim 9 as it appears in the patent, with the addition thereto of the exact limiting words of the disclaimer, is as follows:

“9. The process of concentrating powdered ores which consists in separating the mineral from the gangue by coating the mineral with oil in water containing a small quantity of oil, agitating the mixture to form a froth, and separating the froth,”

when

“the results obtained are the results obtained by the use of oil in a quantity amounting to a fraction of one per cent. on the ore”.

It is to be noted that claim 9 corresponds very closely in its language to claim 12 and that like claim 12 it prescribes first “coating the mineral with oil in water” and thereafter “agitating the mixture to form a froth.” But its language is broader than claim

12, because the words "to cause the oil-coated mineral to form a froth" of claim 12 are replaced by the words "to form a froth" in claim 9. It does not therefore specify that the froth is a mineral froth, as does every claim held valid by the Supreme Court, but this unnecessary breadth is cured by the disclaimer. The concluding words of claim 9 are also somewhat broader than those of claim 12, the words "separating the froth from the remainder of the mixture" of claim 12 being replaced by "separating the froth." Here also the unnecessary breadth of language has been cured by the disclaimer. Claim 9 is the broadest claim of the patent, and as limited by the disclaimer gives to the patentees that broad protection which is as wide as the invention and covers the new art which the patentees have added to the wealth of the metallurgical world, the process of air-froth flotation.

Claim 10 adds to claim 9 the words "warming the mixture," i. e., warming the pulp. This covers everything that the appellant has done up to the end of 1916 and at times thereafter.

Claim 11 adds to claim 9 the words "and a quantity of acid insufficient to cause chemical action on the metalliferous minerals present," i. e., it adds acidification to claim 9 (but not heating) with the qualification that the quantity of acid used shall not be sufficient to cause chemical action on the metalliferous minerals of the ore. This does not exclude chemical action on the gangue constituents of the ore, such as calcite, but only such decomposition of the metalliferous minerals, the

sulphides of the values, and we may add substantial and not negligible decomposition thereof. All of appellant's procedures have employed acid in such manner as to be within the language and scope of this claim.

FILE OF THE PATENT IN SUIT.

This document (printed Vol. 4, pp. 1974-2010) shows that the Patent Office, as a result of its search against the patentability of the invention, did not cite any prior patent or publication whatsoever against any of the claims in issue, or indeed against any claim at any time presented which included the production of froth and the separation of the froth. It further appears that all of the claims in issue were allowed as filed. Therefore there is absolutely nothing limiting in the file-record of the application, and the claims are fully entitled to the broadest construction which the prior art permits. Although the file-record was before the Supreme Court, the Supreme Court did not deem the matter worthy of mention. A consideration of the details of the prosecution of the application is unnecessary.

Nevertheless appellant's counsel in the supplement to their brief, at page 8, quote rejected claim 12 and its rejection by the Patent Office, although they express no conclusion from this part of the history of the patent. This claim was as follows:

“12. The process of concentrating powdered ore which consists in separating the minerals from gangue by coating the minerals with oil in water containing a fraction of 1% of oil on the ore, and recovering the oil-coated minerals” (Vol. 4, p. 1996, upper and cancelled claim 12).

The language of this claim is broad enough to describe a metal-sinking process. There was no suggestion in this claim of aeration or of the action of air bubbles. There was no suggestion of agitation or froth formation or even of flotation. There was absolutely no intimation in this claim that the process produced a mineral froth. It was broader than claim 9 of the patent because it did not even say that a froth was formed. According to this claim the metalliferous minerals might be coated with oil by using soap solution as the pulp liquor, precipitating the oil *in situ* by sulphuric acid, as described in the specification, and thereby producing oil-coated mineral without agitation, and then recovering the oil-coated mineral as a film float or in any manner whatsoever, even by sinking it if that were practicable. The Patent Office Examiner conceded that this claim expressed a novelty over the Sulman and Picard patent No. 793,808 (printed Vol. 4, pp. 2146-2152) the application for which was co-pending with the application for the first patent in suit, but which had issued at the late stage in the prosecution of the application for the patent in suit at which this question arose. That novelty was

“coating the minerals with oil in water containing a fraction of one per cent. of oil on the ore”.

The Examiner's position was that this expressed “merely a difference of degree” (p. 2004) over 793,808 and one of the Cattermole metal-sinking process patents No. 763,260 (printed Vol. 3, pp. 1250-1253), i. e., it was a claim for a reduction in the amount of oil *per se*,

which, although concededly new, could not alone be made the subject of a patent.

This action by the Patent Office conceded the novelty in the minute oil proportion which characterizes the invention and merely objected to a claim which did not include the essentials of the process. The Supreme Court of the United States in the Hyde case reached the same conclusion as to the novelty of the minute oil proportion, and broadly sustained claim 12 of the patent, which is identical in language with abandoned claim 12, except for the added words "agitating the mixture to cause the oil-coated mineral to form a froth," as a claim properly defining the invention.

In the decision of this court in the Hyde case reference is made to the cancellation of this original claim 12 as constituting an admission by the patentees that mere novelty in the amount of oil was unpatentable (214 Fed. 109). No exception is taken to this conclusion. The novelty consisted in the successful utilization of an air-lift (as contradistinguished from an oil-lift), and the production of an air-froth (as contradistinguished from an oil layer or an inflated magma or a film or skin float) carrying the mineral particles. The essentials of the invention were not pointed out in this abandoned claim 12, and it was properly abandoned.

HISTORY OF THE INVENTION—RESEARCH PERIOD PRECEDING DISCOVERY.

In the Hyde suit the defendant issued an open commission to London for the taking of testimony in his behalf, and called as his witnesses Messrs. Sulman, Picard and Ballot, the joint inventors, and Mr. Arthur Howard Higgins, their metallurgist, who actually carried on under their direction the experiments which resulted in the discovery of the invention. The result of this testimony in strengthening the presumptions arising from the patent itself appears in the opinion of the Supreme Court of the United States, wherein this testimony, which is also before this court, is referred to at some length (Opinion, pages 4, 5).

During the year 1902 and succeeding years, and until March, 1905, when the process of the patent in suit was discovered and invented, Messrs. Sulman, Picard and Ballot were at work studying and improving the Cattermole metal-sinking process (Ballantyne, Vol. 2, pp. 362-364). Their investigations covered a wide range, including painstaking but futile efforts to utilize air and gases in flotation, but failed to develop during this period any procedure capable of taking the place of the Cattermole metal-sinking process. Occasional flotation of metal or failure of metal to sink in the Cattermole upcasts, was troublesome, as it meant of course that the metal which did not sink went to waste with the gangue, but nevertheless metal flotation was investigated, and the ingenuity of the inventors was applied to it, and it was tested and to some extent patented, and finally dropped as practically useless, except as a tail-end

annex to the Cattermole metal-sinking process for the recovery from the final tailings of that process, by film or skin flotation, of a small fraction of metallic matter which the Cattermole process was unable to recover. This appears in the report of May 18, 1904, of Messrs. Sulman and Picard to the plaintiff reporting the joint work of Messrs. Sulman, Picard and Ballot (Sulman, Vol. 4, p. 1669, XQ156; p. 1613, Q33) under the heading "Clean-up of Dirty Sands" (Vol. 3, pp. 1078, 1079). This was their final solution of the utilization of flotation ten months before the discovery of the process of the patent in suit, and all their further efforts were concentrated upon the improvement of the Cattermole metal-sinking process.

In July, 1903, Messrs. Sulman and Picard invented the process disclosed in their patent No. 793,808 (Sulman, Vol. 4, p. 1603, Q4, Qs6-8; Picard, p. 1683, Qs5, 6). This process, although never developed to any utility, was patented and the patent was pleaded and put in evidence in the Hyde suit (printed Vol. 4, pp. 2146-2150). In this process an effort was made to recover the metal by flotation as a metallic film on the surface of the water of particles brought to the surface by air or gas bubbles and left floating at the surface by the bursting of the bubbles on their emergence from the liquid, or deposited on the surface from above and floating thereon as a metallic film. Efforts to develop it were abandoned because it was a hopeless process (Sulman, Vol. 4, p. 1623).

In August, 1903, through the publication of the British patent to Froment No. 12,778 of 1902 (Sulman,

p. 1605, Qs9, 10; Ballot, p. 1743, Q88), they learned that the idea of floating oily flocks of metallic particles by bubbles of gas chemically generated had been anticipated by Froment. It was this circumstance which induced them to purchase the Froment patent and all improvements thereon for £225 sterling, or a little more than \$1,000 (Vol. 3, p. 1213), negotiations for that purchase having been commenced in August, 1903 (Ballot, Vol. 4, p. 1771, RDQ149), and the purchase completed in November, 1903 (p. 1770, RDQ144), when they still had hopes of developing something out of their film flotation process.

Another flotation process produced while the Cattermole metal-sinking process was being developed was that which is disclosed in the Cattermole, Sulman and Picard patent No. 788,247, known as the Soap and Flotation patent (Sulman, Vol. 4, p. 1662, Q143; p. 1605, Q8). This patent (pleaded and put in evidence in the Hyde suit, printed Vol. 4, pp. 2143, 2144) is merely for the application to all that was known of the flotation of metals in 1903, of the operation wherein soluble soap is dissolved in the water of an ore pulp, the soap is decomposed by sulphuric acid, and oleic acid is precipitated throughout the mixture to coat the metallic particles, and after the metallic particles have been concentrated they are treated with an alkali to clean off the oil and to again form soap which can be again used in the process.

The two reports covering the period of the initial work in film flotation, those of May 5, 1903 (Vol. 3, p. 1027), and September 24, 1903 (p. 1031), are entitled

“Cattermole Process” and limited to the work thereon. The first reference in the reports to any effort to utilize flotation appears in the report of March 4, 1904 (pp. 1064-1067). These tests were incidental to the completion of an experimental Cattermole metal-sinking plant which Mr. Chapman took with him to Australia in April, 1904, for the purpose of testing it there and erecting there a large commercial plant to carry on the Cattermole process. The experiments are described in the report under the heading “Flotation Factor Used,” but it appears that what was thus described as flotation was merely the upward movement of thickly coated oiled metallic particles in suspension in an up-current of water in an upcast as a tail-end treatment for the recovery of a very small fraction of the metal in the tailings. Two tests are thus described, and in the last run, No. 4, chemical generation of gas was tried, but the “concentrates obtained 1.6%” of the metal originally in the ore (p. 1067), were not encouraging. We therefore find that in the next report dated April 19, 1904 (pp. 1068-1074), four days after Mr. Chapman had sailed for Australia taking with him the experimental Cattermole plant (p. 1073), further work on a duplicate of that plant was supplemented by vanning experiments, and chemical generation of gas was tested therewith, and modifications of shaking tables were devised, and finally on May 18, 1904, we find the climax of all flotation work prior to the discovery of the process of the first patent in suit in the following statement under the heading “Clean up of dirty sands”:

“This work gives considerable promise of early success
As foreshadowed in our last, we have converted the small

model vanning table into a 'bumping' table, and have removed the riffles. By this means on small samples of dirty sands we have been able to clean up nearly all the contained oiled mineral, and to produce sharp, clean sands without the use of any gas producing carbonate, etc., thus effecting considerable economy both in acid and carbonate. Under these conditions mere contact of the oiled particles with air when exposed on the surface of the table is sufficient to insure their flotation removal from the sands'' (Vol. 3, p. 1078, 1079).

This skin flotation produced by exposing the metal particles to air and then permitting them to float by surface tension was actually used in the Cattermole plant erected in Australia (Chapman, Vol. 2, pp. 244, 245, Q20), and the Cattermole plant, with a capacity of treating 100 tons a day of twenty-four hours (p. 243, Q18), was completed and started in operation in April, 1905 (Q21). The oil consumption, however, alarmed the mine owners, and the plant, after running for a few days, was changed over so as to spoil the Cattermole process and make all the recovery on the skin flotation tables (Q22). This occurred after the discovery of the process of the patent in suit, but in ignorance thereof, as will later appear.

HISTORY OF THE INVENTION—DISCOVERY.

The discovery was made in the week between March 3 and March 10, 1905. The work of the laboratory for ten months had concerned only the Cattermole process. A Cattermole plant capable of treating 100 tons of material per day was in process of erection at Broken

Hill, Australia, and the work in London was for the purpose of acquiring information which would be useful in carrying on the Cattermole process. It had been found that heat assisted this process. It had been found in the laboratory that a single stage agitation (Vol. 3, pp. 1088, 1089, par. 5), reduced the oil consumption down to the lowest point ever reached in carrying on the Cattermole process, to wit: 1.5% of the ore (pp. 1093, 1094, 1095, 1096), and a very comprehensive investigation was being carried on of the influence of seven factors "on granulation" (pp. 1099, 1100). Six of these subjects of investigation were the essential factors which contributed to the discovery. These six factors as stated by Mr. Ballantyne (Vol. 2, pp. 369, 370) may be paraphrased as follows:

- (1) Agitation and aeration such as was obtainable in the Gabbett or cone mixer,
- (2) The use of oleic acid in place of the emulsions which characterized the earlier Cattermole work,
- (3) Heating of the pulp,
- (4) Fine crushing without desliming,
- (5) Reduction of the quantity of oil, to be continued regardless of results, and the experiments fully reported,
- (6) Acidification of the pulp.

When these factors were assembled and the quantity of oil was reduced step by step to the lowest limit and the work was carefully, accurately and thoroughly done, we now know that the discovery of the process in suit was inevitable.

Mr. Arthur Howard Higgins carried on these experiments under the direction of the inventors. He testifies as to having received instructions to carry out these

experiments (Vol. 4, pp. 1801, 1802, Qs63-66), and that these instructions were to start with "the upper limit of Cattermole's specified quantity, and reduce this as far as possible. In other words to find the lowest limit at which results could be obtained by the use of oil" (pp. 1817, 1818, XQ139). Contrasting these investigations with his earlier work, he says as to this earlier work, that the quantity of oil "was always adjusted to give good granulation" (p. 1798, Q43), and further:

"Q44. In adjusting the oil to give the best granulation, I presume you experimented with different quantities of oil?

A. Yes, there may have been different quantities, but whenever the granulation became imperfect by reason of the drop in the quantity of oil, the oil was naturally increased" (p. 1798).

Three sets of documents written at the time record the discovery. They are the reports of Messrs. Sulman and Picard, the reports of Mr. Higgins, and the weekly letters of Mr. Ballot to Australia. First we have the Higgins Report of March 2, 1905 (Vol. 3 pp. 1091-1097), and the Sulman and Picard Report of March 3, 1905 (pp. 1098-1106) describing the investigations up to this date and the scheme thereof, with no mention except of granulation. Then the Higgins Report of March 16, 1905 (pp. 1108-1112), detailing the crucial experiments and announcing the result. The opening statement of this report is

"The effect of diminishing the percentage of oleic acid is to alter the type of oiling; the higher percentages producing granules, and the lower ones froth" (p. 1108).

In the carefully tabulated description of experiments we find that with oil "0.32% on ore," the "float vastly increased," and that with oil "0.1% on ore," again the "float vastly increased" (p. 1109). Experiments were tried with one-tenth of one per cent. of oil, and variations of the time of agitation, $4\frac{3}{4}$ minutes, 8 minutes, 12 minutes and 10 minutes, and the last experiment (pp. 1109, 1110) with "5cc. oleic acid" (one-tenth of one per cent.) and ten minutes agitation, was selected for analysis, and the froth concentrates were found to have recovered 87% of the metals.

The weekly letters of Mr. Ballot to Australia are only copied in the record so far as pertinent. On March 3, 1905, Mr. Ballot wrote sending copies of the Sulman & Picard Report of March 3, 1905 (Vol. 4, p. 1717). On March 10, 1905, six days before Mr. Higgins' report of the discovery, Mr. Ballot wrote as follows:

"I am pleased to tell you that during the week we have made some very important discoveries which will, I think, almost revolutionize our processes by way of simplifying and cheapening the same. I hope that by next mail the work will be sufficiently far advanced to send you full particulars. Several points have yet to be determined and the discoveries are of such a nature that we have decided to take our expert and counsel's opinion thereon with a view to assuring ourselves that we can get good protection under patents. I may mention for your private information that we do not use more than 0.1 per cent. of oleic acid per ton of ore and although we have not assays out that the recoveries will be very satisfactory" (pp. 1717, 1718).

This is the earliest document describing the invention, and fixes the date of invention as between March 3 and March 10, 1905. It shows Mr. Ballot's full knowledge

and appreciation, and that patenting was even then under consideration.

One week later, on March 17, 1905, Mr. Ballot wrote, giving a remarkably full description and enclosing a copy of Mr. Higgins' report of the day before, "received this morning" (pp. 1718-1720). Every feature of the invention is accurately described.

The evidence as to instructions to Mr. Higgins, aside from his own frank statements above noted, is full and complete (Ballot, pp. 1756, 1757, Q120; p. 1758; XQ127; Sulman, pp. 1645, 1646, Qs100-104; Picard, p. 1686, Q18). Mr. William Ballantyne, the British patent agent who prepared the patent application, was frequently consulted (Vol. 2, pp. 364-366, Q10). He testifies as to the assembling of the factors, the drawing up of the series of tests, the declared intention to "reduce the proportions of oil to a vanishing point" (p. 368), and the disclosure to him on one of the days between the 8th and 15th of March, 1905, by Messrs. Sulman, Picard and Ballot of "their startling discovery of the agitation froth process" (p. 368) and describes a demonstration made to him early in April, 1905, which, with his full knowledge of all that had been done before, he regarded as "little short of a miracle" (*idem*) He also describes the diligent following investigations resulting in the production of the continuous apparatus shown in the patent (p. 371).

This brings us to the Sulman & Picard Report of May 3, 1905, reporting the work done up to that time in working out "the new method of oil concentration" in detail

for forwarding to Australia (Vol. 3, p. 1113). The report says:

“In determining the lowest limit of oleic acid which could be employed in granulating, it was found that granulation practically stopped at a range of about 0.5 per cent. of oleic acid on the mineral [ore] (60 mesh Broken Hill), in an acid circuit somewhat below 1 per cent. in strength.

A certain amount of black mineral froth was, however, noticed as a result. On successively decreasing the amount of oleic acid *below* .5 per cent. it was found that whereas granulation ceased there was a growth in the amount of mineral float-froth under these conditions, and that the production of such float-froth appeared to reach a maximum when about .1 per cent. of oleic acid on mineral was used. This froth on collection was found to consist of oiled mineral slimes mechanically holding more or less coarse (oiled) mineral particles, the froth carrying between 70 to 80 per cent. of the total mineral present in the charge. The gangue slimes and the coarse sands are left quite white in the liquor below the froth, and the balance of the coarse mineral not caught up in the black froth, but remaining fixed with the sands, is found to have been efficiently oiled and to be capable of complete recovery from the sands by table aeration” (Vol. 3, pp. 1113, 1114).

With the obvious correction noted in the bracket, this exactly sums up the newly discovered process as applied to Broken Hill ore with oleic acid as the oil.

Then follows a statement describing investigations which satisfied the inventors that the froth was due “to the air introduced by the Gabbett cone during agitation” (p. 1114), that the production of froth was to some extent dependent upon “the amount of mineral slimes present and the fineness of the grinding” (p. 1115).

The continuous plant shown in Fig. 1 of the drawings of the patent in suit was here first described (pp. 1117-1120) and was shown in a drawing made by Mr. Sulman and annexed to the report (p. 1302) and all the methods of supplemental treatment referred to in the patent are described (pp. 1121, 1122) except the superaeration method, a later modification of the invention. In this continuous plant the cones of the Gabbett mixers were "speeded at from 1000 to 1100 revolutions per minute" (p. 1117), this being a slightly higher speed than the 900 revolutions per minute used at the time of the birth of the invention in suit (Higgins' Report, March 2, 1905, Vol. 3, p. 1094; Higgins, Vol. 8, p. 4534, Q358). The language above quoted was also quoted in the decision of the Supreme Court (Opinion p. 5), and clearly shows that the Supreme Court accepted the evidence as presented, that from the discovery between March 3 and March 10, 1905, until the completion of the first continuous apparatus, reported in May, 1905, the then recognized importance of aeration had brought about an increase in agitation for the purpose of increasing the aeration. Indeed, the Cattermole process having been now revolutionized, and the aeration which did not aid the Cattermole process being a vital and essential factor of the new process, it was in the natural order of development that aeration should be increased after the invention in suit had been discovered, demonstrated and taken as the basis of all further development.

A copy of this report of May 3, 1905, and its drawing were immediately sent to Australia, as appears from the memorandum on the report "Copy sent to C. F. Court-

ney and Geo. A. Chapman 5/5/05—May 5, 1905” (Vol. 3, p. 1113), and a similar memorandum on the drawing (p. 1302). Mr. Chapman testifies to receiving in June, 1905, instructions from Mr. Courtney, to whom all of Mr. Ballot’s letters had been addressed, to change the Australian plant to take advantage of the discovery, and to receiving a drawing which he particularly identifies as a copy of the drawing attached to the report of May 3, 1905 (Vol. 2, pp. 245, 246, Q23), and says:

“Owing to the trouble which had been met with in working our previous method, as a practical man, I was very much gratified and relieved to know that we could substitute this more simple and ingenious process.”

This marked the commencement of the commercial use of the invention in suit, which will be hereafter referred to under that heading.

It may be noted generally as to the reports in evidence, prepared merely for the records of the company, the only remarkable fact is that they contain as much information as is contained in them. Very many subjects are only touched upon in the reports. For example, in the Higgins report of March 2, 1905, it is stated that during experiments directed by Mr. Sulman to determine the rate of change of granulation with temperature, the influence of other conditions was sufficiently marked to suggest their improvement, and that these conditions have been carefully examined (Vol. 3, pp. 1091, 1092), but nothing identifiable by the reports alone further appears as to these other conditions. Mr. Higgins testifies as to these other conditions. (Vol. 4, pp. 1818, 1819, XQ143), which are evidently of no importance in this

controversy, although one of them, as to the relation of the size of the revolving cone to the size of the vessel in which it revolves, is referred to at the end of Mr. Higgins' report of March 16, 1905 (Vol. 3, pp. 1111, 1112).

Again, comparatively little appears as to the investigations of the Froment process and the process of patents Nos. 793,808 and 788,247, but this merely shows how relatively unimportant these useless flotation processes were. As Mr. Higgins says of his tests of the Froment apparatus in May or June, 1904:

“At that time a good many failures were only reported orally” (Vol. 4, p. 1809, Q99).

It is plainly apparent from the reports that up to the time of the discovery of the process of the patent in suit, the one reliable process of ore concentration of Minerals Separation, Ltd., was the Cattermole process, and that after the discovery of the process of the patent in suit the Cattermole process disappeared.

COMMERCIAL USE OF THE INVENTION—AUSTRALIA.

The commercial use of the invention of the patent in suit commenced immediately after that invention was made. The rapidity with which the process was put at work was truly remarkable. The invention was made between March 3 and March 10, 1905, and carefully and thoroughly investigated and tested, and the results of these investigations are fully stated in the Sulman and Picard Report of May 3, 1905, above referred to. This report went immediately to Australia, for Mr. Chapman

testifies that he received a copy of the drawing annexed to the report, which he identifies, and instructions relating to the process, in June, 1905 (Vol. 2, pp. 245, 246, Q23), and immediately went to work and altered the Cattermole 100-ton plant so as to carry on in it the process of the patent in suit (Q24).

The first large scale installation made in Australia, 12,000 miles from London, almost exactly reproduced the continuous apparatus which had been worked out in the London laboratory and completed in May, 1905. The invention was thus put to work on a large scale, treating the theretofore untreatable residues of former mining and ore concentrating operations which constituted the great tailings dumps at Broken Hill, Australia,

“some ten to twelve million tons of mill residues, containing the major portion of the original zinc content” (Hoover, Vol. 4, p. 1783, XQ34).

The plant as described in the specification of the ~~patent~~ patent in suit and in the Sulman and Picard report of May 3, 1905, and as constructed in Australia for the Cattermole process, contained a tail-end shaking table annex. This was soon abandoned. Mr. Chapman says:

“The work on these tables was never really satisfactory, and an examination of the tailings showed the sulphide mineral losses to be in the form of a potential froth. A few experiments showed that it was only necessary to give these a slight agitation to bring about further air-bubble attachment, and this potential froth then became a real froth on passing it to another spitzbox. This second spitzbox was placed immediately below the first spitzbox, and the tailings were brought with a good splash on to suitable baffles and boards of the second spitzbox. From this date onward the tables for the

retreatment of tailings from flotation treatment were discarded'' (Vol. 2, pp. 247, 248).

The details of the improvement in the agitator wherein the revolving cone was replaced by revolving blades are described (pp. 248, 249, Q27), and the additional plants constructed are identified (p. 250, Q30), it being noted that they ''had a total capacity of over 10,000 tons per week'' (*idem*).

The details of these further plants are described (Qs32, 33), and it appears that all of these plants were operated successfully and profitably (p. 254, Q36). The apparatus as used in Australia when Mr. Chapman left there in May, 1908, was such as is generally shown in the drawing, Complainant's Exhibit Drawing, Australian Model Plant (Vol. 3, p. 1303), showing seven agitating compartments arranged in series and a number of spitzkasten also arranged in series, but with provision for the tailings of the first spitzkasten to drop with a splash upon an apron leading to the second, and so on, all as described by Mr. Higgins (Vol. 4, pp. 1815, 1816, Q136), who visited Australia in 1908 (p. 1814, Q128).

It is to be noted that it was in the development of the plants at Australia that the so-called ''beater'' form of agitator was adopted, by substitution of revolving blades for the smooth surfaced cones. As a matter of fact, however, these blades formed a vortex just as the cone had done, in consequence whereof air was drawn down from above the pulp and entered near the bottom of the pulp. Air was drawn rather than beaten into

the pulp, but after it had entered the pulp was beaten up into smaller bubbles. This was the form of agitator and aerator in use by both the plaintiffs and the defendant at the time of taking the testimony in the Hyde suit, and that fact accounts for the frequent reference in that suit to beating in the air to form the froth.

The testimony as to these various plants on the property of the Sulphide Corporation at Broken Hill, Australia, was brought down as nearly as possible to date in the Hyde suit by the deposition of A. W. Wincey, mill superintendent of this company (Vol. 2, p. 501, Q1), who left Broken Hill in the summer of 1912, and came to London and testified there (Q2). Mr. Wincey's work for the Sulphide Corporation commenced in June, 1906, while Mr. Chapman was there, and continued up to the time of his departure for London (p. 506, Q23). When he started at work three-quarters of a million tons of dumps, owned by his company, awaited treatment. These have all been changed into valuable concentrates by the process of the patent in suit (Qs24, 25). Mr. Wincey produces four photographs, taken the day before he left Broken Hill, of one of these flotation plants (Vol. 2, pp. 501, 502, Qs3-5) and these photographs are in evidence (Vol. 2, p. 502; printed Vol. 3, pp. 916, 917, 920, 921). Further improvements and the use of an essential oil have resulted in reduction in the quantities of oil, and the standard oily liquid in use when he left Australia was a mixture of "eucalyptus oil and oleic acid in the total proportion of .9 to 1.3 lbs." per long ton of ore (Vol. 2, pp. 505, 506, Q21), being .04% to .06%.

As to the magnitude of these operations, it is proved that the total tonnage of material treated at Broken Hill, Australia, according to the official returns made by licensees up to June 30, 1912, was about 2,250,000 long tons, and the total tonnage of zinc-lead-silver concentrates recovered more than 800,000 long tons (Vol. 3, p. 1014). As to the financial returns, the value of the concentrates recovered by the principal licensee, the Sulphide Corporation, in its individual operations whereby 445,299 long tons of concentrates were produced from 1,176,934 long tons of material treated, was £1,154,353 or more than \$5,250,000, and the profit was £650,153 or more than \$3,000,000 (p. 1016; Keating, Vol. 2, p. 491, Q5). Additionally at the plant of the Sulphide Corporation there were joint ventures of Minerals Separation, Limited, Lazard Brothers & Co. and the Sulphide Corporation wherein 636,799 long tons of material were treated and 216,181 long tons of concentrates were produced at a value of £635,371 or about \$3,000,000, at a profit of £181,688 or about \$885,000 (Vol. 3, p. 1011).

Another important operation in Broken Hill, Australia, was that of the Zinc Corporation which has extensively used, and is now extensively using, the process of the patent in suit under license from the plaintiff, Minerals Separation, Limited. This Corporation made returns, proved up to June 30, 1912, of 380,020 long tons of material treated and 132,675 long tons of concentrates obtained and additionally thereto a settlement on the basis of 12,000 tons of concentrates obtained (p. 1014). The exact values of these concentrates was not provable,

but computing them at the same value as that of the Sulphide Corporation operations covering substantially the same period, their value was about \$1,800,000. This makes a total of more than 10,000,000 tons treated with profits in the neighborhood of \$5,000,000 on returns up to June 30, 1912. The evidence as to the Australian use of the invention beyond this time was not available or indeed necessary to prove the immense value of the invention.

COMMERCIAL USE OF THE INVENTION—RUSSIA.

Mr. Chapman's next work of installation was at Orijarvi, Finland, Russia, and he went there in June, 1911 (Vol. 2, p. 276, Q84), and installed a plant which was operated in accordance with the process of the patent in suit, and the installation was highly successful and doubled the recovery of the valuable metals of previous water concentration plants (Qs84, 85). The oil used was a mixture of oleic acid and eucalyptus oil, oleic acid from .5 to two pounds per ton, eucalyptus oil .2 pounds per ton; and the sulphuric acid consumption was between sixteen and twenty pounds per ton (p. 281, Qs102, 103). The capacity of the plant was from fifty to seventy-five tons per day (Q107).

COMMERCIAL USE OF THE INVENTION—SWEDEN.

The next commercial installation made by Mr. Chapman was at the Saxbergets mine, Rafola, Sweden, and here he installed the process in a plant divided into two parts, one treating the crude ore and the other retreating

the concentrates (Vol. 2, p. 276, Q87). This doubled the capacity of the mine with the same quantity of crude ore as formerly treated (*idem*).

A very interesting feature of the work at this Saxbergets mine, was that the mixed concentrates of lead and zinc were fed directly from the flotation plant through magnetic separators, wherein the worthless magnetic pyrites or iron sulphides were removed, and were then passed over shaking tables to separate the mixed concentrates.

“This series of retreatments were conducted on the concentrates without any special preparation. The small quantity of oil on these concentrates rendered this unnecessary” (p. 277, Q87).

This Swedish plant had a capacity of from one hundred to one hundred and fifty tons per day (p. 200, Q108). The oil used was wood tar oil in the proportion of four pounds per ton of ore treated, and sulphuric acid was used in the proportion of five or six pounds per ton (Qs104-106).

This installation was made during June and July, 1912 (Vol. 2, pp. 277, Q89), just before the taking of the testimony in London. When Mr. Chapman left the plant, late in July, 1912, the recoveries were over 90 per cent. zinc, and as he said when testifying, this good work was “being maintained” (Q87).

COMMERCIAL USE OF THE INVENTION—WALES.

Among the operations fully described in the London testimony in the Hyde suit there is one other installation,

not at a mine, but at a smelting works, which remains to be considered. This was at the Emu Works near Swansea, South Wales, Great Britain. This Welsh plant was installed not for the purpose of producing concentrates for sale, but for the purpose of testing on a fairly large scale a briquetting zinc smelting process (Ballot, Vol. 4, p. 1715, Q14), invented by Mr. Picard, one of the patentees of the patent in suit (Sulman, Vol. 4, p. 1664, XQ145; Morris, Vol. 2, p. 473, Q11). This plant treated something more than 200 tons of ore (Chapman, p. 273, Q76), and produced approximately 120 tons of concentrates (Morris, p. 473, Q9). The concentrates were put through the smelting process and the products of the smelting furnace were sold (p. 478, RDQ38). The ore treated had been brought from the San Francisco Del Oro Mine in Mexico (p. 473, Q6).

The peculiarity of this operation was that the ore treated contained such a very large percentage of calcite, about 5 per cent. (Chapman, p. 300, XQ179), and this calcite caused such a wasteful consumption of sulphuric acid, that the process as usable with this zinc-lead ore could not be successfully applied to the ordinary work of concentration at this mine. As Mr. Ballot testifies, a license was granted to the mine, but the process was not installed there because the result would not be commercial by reason of the cost of sulphuric acid (Vol. 4, pp. 1739, 1740, Q77).

The operations were carried on during the first three months of the year 1910 (Vol. 2, p. 269, Q262; p. 270, Q65). Heat and sulphuric acid were both used. When the sulphuric acid came in contact with the ore, however,

it promptly acted chemically on the calcite and was thereby consumed, and before the condition of acidification of the pulp could be attained and the physical action of the sulphuric acid utilized it was necessary to waste sulphuric acid in this useless chemical reaction. This chemical reaction produced the gas carbon dioxide, but this gas was a wholly useless diluent of the air with which the pulp was treated, and was, in fact, largely carried out of the pulp by the great volumes of air introduced in the operation.

The theoretical acid consumption in the treatment of this ore, that is to say, the amount of acid necessary to decompose the calcite in the ore, plus the additional amount necessary to produce acidification of the pulp, exceeded 100 pounds to the ton (Chapman, p. 280, Q100). In practice it was found that by dividing the acid addition up among four of the agitating compartments it was possible to economize this acid consumption (*idem*) so that it was actually reduced to from 60 to 70 pounds per ton (Q98). With this arrangement it was possible to produce a high grade concentrate at the expense of a reduction in recovery, but as the plant was never run for recovery, but only for the production of concentrates for use in the briquetting-smelting process, this arrangement whereby some part of the wasteful acid consumption was reduced, was not objectionable for that plant (Q101). Under these conditions the process of the patent in suit was carried on in a satisfactory manner and a good thick froth carrying a mixed concentrate of lead and zinc sulphide was produced (pp. 270, 271. Q67, Q71). The principal frothing

agent was oleic acid in the proportion of two pounds per ton, although it was mixed with the soluble frothing agent amyl acetate in the proportion of from .25 pounds per ton up to .5 pounds per ton, and for two days amyl acetate was used alone in the proportion of one pound per ton (pp. 279, 280, Qs96, 97).

As a matter of fact this operation gave a striking example of the wastefulness of the chemical reaction of sulphuric acid upon limestone, but the defendant seized upon it as the basis of an effort to prove the identity of the process of the patent in suit and the worthless Froment process, and in consequence there was a long cross-examination of Mr. Chapman as to the operations at the Emu plant which only accentuated the fact that the Froment reaction, which could not be avoided in the treatment of this ore with the addition of sulphuric acid, was wasteful and useless. This part of the cross-examination commences on page 297 (XQ164), and runs through very nearly to the end of the cross-examination. Briefly Mr. Chapman says that the sixty or seventy pounds of sulphuric acid per ton of ore was immediately consumed by the calcite in the agitating vessels (XQ164); that a considerable amount of carbon dioxide was generated and that the working temperature was 65° to 70° centigrade (149° to 158° Fahrenheit) (XQs169-173); that this gas was generated immediately like the explosion in the Froment test tube (XQ198); that the production of this gas never entered into the calculations of the metallurgists who were operating this plant, except as a factor compelling a large consumption of sulphuric acid, and that

the sulphuric acid was added in installments so as to give it a little chance to cut out the gangue before it was consumed, and that under the conditions of agitation and high temperature, the enormous volumes of air entering and leaving the pulp were quite sufficient to carry the carbon dioxide out of the pulp so that only a small proportion of the gas could reach the spitzkasten, and that as a matter of fact the production of carbon dioxide in each mixer per minute was only six-tenths of a cubic foot and this quantity was exceedingly small when compared with the enormous quantity of air entering and leaving the pulp (XQ199). Mr. Chapman further says that in his opinion no production of froth resulted from the evolution of carbon dioxide (XQ204); that the air had many hundred times the influence in froth production of carbon dioxide (XQ205); that he had only to look into one of the agitators to realize the enormous volumes of air entering and leaving the pulp compared with the comparatively small amount of carbon dioxide being evolved (XQ207), and that they were so sure that the froth was an air-produced froth that they did not give the matter of carbon dioxide production any serious consideration except that, as the first consideration was economy of reagents, they took every precaution to economize sulphuric acid (XQ212), and that although not intending to take advantage of the accidental presence of the relatively small amount of carbon dioxide, they could not prevent it (XQ213). Mr. Chapman also testifies that the wasteful consumption of sulphuric acid due to the presence of calcite has been one of the biggest difficulties encountered in his

work for the plaintiffs, and that he had spent nearly ten years in experimenting to overcome it (XQ214).

**COMMERCIAL USE OF THE INVENTION—SOUTH AMERICA—
BRADEN MINE.**

The installation at the Braden mine in Chili, South America, was mentioned in the testimony taken in London in the Hyde suit. Mr. Chapman testifies to having carried out a large number of tests on the ore of this mine which determined that with the ore crushed to 80 mesh, ordinary atmospheric temperature conditions, an acid consumption of five to six pounds per ton and a consumption of frothing agents of three pounds of Texas fuel oil and one pound of American wood tar oil per ton of ore, recoveries would be 85 to 90 per cent. of the copper content of the ore in a concentrate assaying 10 to 15 per cent. of copper, the original ore content being roughly 3 per cent. of copper. He further said that the installation of a large plant for the treatment of 1,200 tons of ore per day was then taking place as a result of trials carried out in a smaller plant treating 250 tons per day (Vol. 2, p. 284, Q112). This testimony was given during the summer of 1912.

At the trial Mr. Chapman testified that he went to these mines in September of the following year, 1913 (Vol. 7, p. 4093, Q4); that he found installed there seven 600-ton standard Minerals Separation flotation machines (capacity 4,200 tons per day), not giving good results because of bad milling, and that he and Minerals

Separation's Chief Engineer, Mr. Walter Broadbridge, improved the recovery to above 80% total copper (Q5), including oxidized copper, and between 90% and 95% sulphide-copper (Qs6, 7). The capacity of this plant is about 1,500,000 tons of material treated per year.

It will be noted that the total amount of frothing agents here employed, 4 pounds to the long ton of ore, was .18% of the ore, and that a soluble constituent was present by reason of the use of wood tar oil (Higgins, Vol. 9, p. 4731, Q9), so that the actual amount of insoluble oil present was less than .18%. The amount of petroleum oil present was 3 pounds to the long ton of ore, or .13%. In the presence of the soluble frothing agent this minute amount of petroleum apparently performed a useful function. This is an example of the conjoint use in minute amounts of a frothing oil, a soluble frothing agent and a non-frothing oil.

COMMERCIAL USE OF THE INVENTION—CUBA.

The plant of the Cuba Copper Company was referred to in the London testimony. Mr. Howard, works manager of the London plant of the complainant, testified that he had assisted in the planning of this plant (Vol. 2, p. 344, Q41), and Mr. Ballot testified that one of the engineers of the company was then engaged in the erection of that plant in Cuba (Vol. 4, p. 1742, Q86).

At the trial Mr. Chapman testified that, returning from the Braden mines, he visited these mines at El Cobre, near Santiago, Cuba (Vol. 7, p. 4094, Qs5, 8),

and found installed and operating there a 600-ton standard Minerals Separation flotation machine which he improved to recover 80% of the total copper, with expectations of increase to 85% (Q8). The capacity of this plant is more than 200,000 tons per year of material treated.

COMMERCIAL USE OF THE INVENTION—CANADA.

While the record contains no specific identification of the Canadian licensees in the full list of licensees in the United States, Canada, Mexico, Cuba and South America (Ballot, Vol. 7, pp. 4026-4028, Qs1, 2), evidence was given at the trial of the excellent results obtained in the use of the process in suit by one of these Canadian licensees, Britannia Mining & Smelting Company (now the Howe Sound Company). Mr. Ira L. Greninger, a mining engineer, formerly employed by Minerals Separation American Syndicate (1913) Ltd. (Vol. 7, p. 4043, Q6), and then acting mine superintendent of Inspiration Consolidated Copper Company at Miami, Arizona (Qs2, 3), testifies to an installation made at this mine in June, 1912, of a 50-ton Minerals Separation standard machine (Qs9, 10, 13), for treating the chalcopyrite copper ore, containing about $4\frac{1}{2}\%$ to 5% of copper (Qs11, 12) and employing as the frothing agent wood tar oil mixed with mineral oils (Q14), without acid and without heat (Qs15, 16), in the proportion of about 2 lbs. of oil per ton of ore treated (Q17), with recoveries from 88 to 97% (Q18) and a concentrate containing 20% of copper (Q19). He also testifies to visiting this plant in July 1913 (Q20), and

finding installed there a 600-ton standard Minerals Separation machine (Q22) using the same frothing agents (Q23) with improved recoveries (Q24). He found also that the mill which originally consisted of coarse jigs, fine jigs, tables and vanners, preceded by hand sorting, had been reorganized, with elimination of everything except the fine jigs, the tailings of which were reground and treated in the flotation plant (Q26).

COMMERCIAL USE OF THE INVENTION—MEXICO.

It is in evidence that a license was granted to the San Francisco Del Oro Mine prior to the summer of 1912 but that because of the large amount of sulphuric acid necessary for the treatment of the ore of that mine the process was not installed at the mine (Ballot, Vol. 4, pp. 1739, 1740, Q77). It is also in evidence that some 200 tons of the ore of this mine was treated in Wales, but merely for the purpose of making a test of the Picard zinc bricquetting process (see heading Commercial Use of the Invention—Wales). It is also in evidence that other licenses were granted, for example, to the Cusi Mining Company (Vol. 7, p. 4028), and the wholesale murder of mining engineers at this mine is a matter of general public knowledge. Conditions in Mexico were not favorable for the development of mining properties at and before the trial of this case.

**COMMERCIAL USE OF THE INVENTION—UNITED STATES—
LICENSEES.**

The following is a full list of the licensees in the United States at the time of the trial (Vol. 7, p. 4028, Q2) :

Anaconda Copper Mining Company,
 Arizona Copper Company of Arizona,
 Arizona Copper Company, Ltd.,
 Atlas Mining & Milling Company,
 Atwater, M. W.,
 Broadwater Mills Company,
 Butte Central Mining & Milling Company,
 Cananea Consolidated Copper Company,
 Ceylon Company,
 Chichagoff Mining Company,
 Colusa Parrot Mining & Smelting Company,
 Consolidated Arizona Smelting Company,
 Desloge Consolidated Lead Company,
 Doe Run Lead Company,
 Ducktown Sulphur, Copper and Iron Company,
 Dutch Sweeney Mining Company,
 Elm Orlu Mining Company,
 Ely Associates and Brockman & Co.,
 Engels Copper Mining Company,
 Flint Mines, Ltd.,
 Goldfield Consolidated Mines Co.,
 Highland Valley Mining & Development Company,
 Inspiration Consolidated Copper Company,
 McDonald & Noble,
 Mineral Recovery Company,
 Mountain Copper Company, Ltd.,

Napoleon Mining Company,
Old Dominion Mining & Smelting Company,
Phelps, Dodge & Co.,
Pingrey Mines,
Portland Gold Mining Company,
Reward Gold Mining Company,
St. Joseph Lead Company,
Stoddart Milling Company,
Utah Leasing Company,
Vindicator Consolidated Gold Mining Company,
Weedon Mining Company.

The licenses were all produced and handed to appellant's counsel for examination (Vol. 7, pp. 4026, 4027; Vol. 8, p. 4726) and they made an abstract of such parts as they wished in evidence and this abstract was put in evidence (Vol. 8, p. 4726) as Plaintiffs' Exhibit 291 (printed Vol. 9, pp. 5489-5517).

A full statement of payments of royalty by licensees in the United States (Vol. 9, p. 5334) shows a total payment of \$1,155,258.24 on operations involving the treatment of 12,953,038 tons of material by eleven of the licensees and the recovery of 227,070 tons of concentrates by eleven others of the licensees. Neither the total tonnage of material treated nor the total tonnage of concentrates recovered appears in this statement, by reason of the variant method of returns. So far as available evidence was given of the processes employed by these licensees, and it appeared that the process of the patent in suit was carried on by every licensee of whose operations evidence was available. The inclusion of all patents owned by the appellees

in the licenses, even the earlier patents for the Cattermole and other processes which were either never used in practice or (as to Cattermole only) the use of which was abandoned when the invention in suit came into use, and the inclusion of the soluble frothing agents patent No. 962,678 and all patents for improvements in process and apparatus which have followed the invention in suit, is appropriate in such licenses, but the basic and fundamental patent dominating all operations is the patent in suit. Where soluble frothing agents have been used, they have been used by every licensee, largely if not wholly in association with the insoluble mineral-froth-producing oils of the process in suit. The royalties are paid, primarily, for the use of the process in suit, and the fact that the patent in suit has formed the basis for a great number of improvement patents merely accentuates its importance as a dominating and master patent for a process which started a new art, the art of air-froth flotation.

Anaconda Copper Mining Company. The facts are fully set out by Mr. Albert Edward Wiggin, flotation superintendent for the State of Montana of the Anaconda Copper Mining Company. The Anaconda Copper Mining Company employed the ordinary water concentration process from 1902, in the Washoe Reduction Works, including, from 1912 to 1915, an improved system of water concentration known as the round table plant, developed by Mr. Wheeler and Mr. Wiggin (Vol. 8, pp. 4278, 4279, Q5, and pp. 4318, 4319, RQ119-127), and in 1914, a novel leaching plant. Early in 1914 it was decided to investigate on a fairly large scale the

treatment of slime and mill tailings by flotation. The details of this investigation are set out (pp. 4279-4289, Q6). Care and thoroughness characterized it. As a result it was decided to take a license from Minerals Separation and to remodel the plant for flotation and to scrap the round table plant and to divert the leaching plant to the retreatment of the sands dump. Altogether a going plant of the value of \$859,098.23 was dismantled and scrapped (pp. 4298, 4299, Qs24-26). The remodeling of the concentrator plant was begun in January, 1915, and proceeded, one section at a time, and was completed, the last of the eight sections, about the middle of January, 1916 (p. 4279, Q5).

A full description of the remodeled copper plant is given at p. 4289 to 4293, Q7-13, in connection with flow sheets (Vol. 9, pp. 5342-5346). It consists of eight sections of 2,000 tons a day capacity each. In addition there is a slime flotation plant having a capacity of about 3,000 tons a day, the feed to which is 2,000 tons of current mill tailings and 1,000 tons of the dump or pond slime. This latter is an accumulation of rejected slimes from prior water concentration processes, estimated on January 1, 1916, as 833,758 tons, containing 36,031,725 pounds of copper (p. 4305, Q59 and 60, and p. 4292, Q11).

In the copper concentrator there is used for the copper sand, 3 to 3½ pounds of frothing agent (kerosene acid sludge) and from 6 to 8 pounds of sulphuric acid, per ton of ore fed to flotation (pp. 4290, 4291, Qs7 and 8); and for the copper slimes 5½ to 6½ pounds of frothing agent (3 to 3½ pounds of kerosene acid sludge and

2½ to 3 pounds of wood creosote) and about 15 pounds of sulphuric acid (p. 4292, Q9, p. 4300, Qs32, 33, and Plaintiffs' Exhibits 313-315, Vol. 9, 5555, 5556).

The zinc concentrator plant is described at pp. 4293-4296, Qs15-18, in connection with flow sheet, Plaintiffs' Exhibit 244 (Vol. 9, p. 5346). This zinc concentrator was designed to treat 2,000 tons of ore per day.

In the zinc concentrator there is used 2¼ to 3½ pounds of oil (kerosene sludge acid .7 pounds and wood creosote 2.7 pounds) and 22 to 27 pounds of sulphuric acid, per ton of ore fed to flotation (p. 4295, Q18, and p. 4300, Q32, and Plaintiffs' Exhibits 313-315, Vol. 9, pp. 5555, 5556).

To show the extent of use of flotation at the Anaconda mill, the figures for the year 1916 are given by Mr. Wiggin at p. 4300, Q34; p. 4303, Q47. The total feed to flotation from newly mined ore during 1916 in the copper concentrator was 3,800,750 tons of ore, having a copper content of 106,339,156 pounds. The tonnage of concentrate recovered by this flotation plant during 1916 was 576,417, containing 99,962,700 pounds of copper. The percentage of recovery by this flotation was 94% of the copper contained in the feed to flotation plant (Qs37-40). The grade was about 8.07% copper (Qs51-55).

The total tonnage treated by the zinc concentrator from the time the small concentrator started in January up to April 1st, 1917, was 292,493, containing 78,308,337 pounds of zinc. The recovery was 92.8%. The grade was approximately 33% zinc, a low grade by

reason of the large iron sulphide content of the ore (Vol. 7, pp. 4121-4123, RQs156-166), but adapted to a novel electrolytic precipitation process carried on in Great Falls (p. 4302, Qs41-47).

To indicate what would have been the value of the flotation process to the Anaconda Company in the years gone by, when water concentration was employed and when the reject of that water concentration ran to waste in the valley, Mr. Wiggin makes an estimate as follows. He gives us the total tonnage of ore treated from the time the Washoe Reduction Works started in February, 1902, down to the 31st of December, 1915, as 35,877,044 tons of ore containing, 2,408,629,436 pounds of copper (p. 4304, Q56). Of this the recovery of copper that was actually achieved by the processes actually used was 1,885,859,368 pounds. During that interval sand tailings had run to waste, the impounded remnant of which was estimated on December 31st, 1915, at 17,000,000 tons, containing .65% copper, or a total of 221,000,000 pounds of copper. In addition, slime from the mill prior to the use of the round table plant installation ran to waste, the impounded remnant of which was estimated on January 1st, 1916, at 833,758 tons, containing 36,031,725 pounds of copper (p. 4305, Q59). Mr. Wiggin, assuming that, through the years from February, 1902, to December 31, 1915, on the entire tonnage that was actually treated at the mill by water concentration from year to year, the flotation process had been used, as it was used during the year 1916, and had given the results it did give in 1916, figures that the additional recovery of copper from that tonnage would have been 353,-

010,773 pounds, and assuming the value of that copper at the average market price for copper current during that term of years (figured with reference to the tonnage treated at the mill from year to year) less a reasonable charge for the cost of treatment, he shows that that value would have been \$38,125,163 (pp. 4305-4308, Qs61-64). The Anaconda Company did not earn that sum of money because it did not have the flotation process to use from 1902 to 1915.

To show the value to the Company as an asset on January 1st, 1916, of the 2.16% of copper in the 833,758 tons remnant in the slime ponds on that day (a total loss under prior processes but an asset now because of the advent and adaptability of the flotation process as practiced in the slimes plant of the mill to-day) Mr. Wiggin figures that value, on a reasonable assumption as to the price of copper and after making liberal allowance for the cost of treatment and smelting and converting, as \$4,032,000 (p. 4308, Qs65-68).

It appears that the Anaconda Co. has a 2500 ton leaching plant that is being used to treat by leaching the 17,000,000 ton sand tailings dump, the reject of former water concentration processes (p. 4313, Qs87-93, and p. 4318, RQs114-118). This leaching process and the idea of building this leaching plant all came before flotation was tested (RQ116). The leaching plant was originally built to treat the sand tailings produced in the mill, the current tailings from the tables (RQ115). When flotation was tested, it was substituted as the process and the plant for treating the current mill tailings, and this

then almost new and costly leaching plant was diverted to another and inferior use (RQs117, 118).

It appears also that the advent of flotation in the Anaconda mill destroyed the reasonable hopes of the witness Wiggin and his co-inventor, based upon their round table invention, which was the best slime concentrator of the water concentration class, and, as such, seemed to have a future (RQs119-127).

Mr. Chapman, who had charge of the experimental work of this installation as the representative of plaintiff Minerals Separation, Ltd., also testifies in general corroboration of the facts fully related by Mr. Wiggin (Vol. 7, pp. 4101-4106, Qs47-66).

Elm Orlu Mining Company and Colusa Parrot Mining Company—Timber Butte Mill.—The facts in this regard are testified to by Mr. William Nicholas Rossberg, superintendent of the Timber Butte Mill (Vol. 8, pp. 4362-4387).

The Elm Orlu Mining Co. and the Colusa Parrot Mining Co. are licensees under the patent in suit and the results of the process as employed at the Timber Butte Mill are of special interest because the Elm Orlu zinc ore is so nearly identical with the defendant's Black Rock Mine ore.

At the Timber Butte mill there is both a zinc concentrator treating this Elm Orlu zinc ore, and a copper concentrator treating the reject or dump of the old reduction works of the Colusa Parrot reduction plant.

Mr. Rossberg gives a description of the zinc concentrator at p. 4363, Q6, to p. 4371, Q33, in connection

with flow sheet, Plaintiff's Exhibit No. 246. This zinc concentrator was completed and put in operation in June, 1914, and has remained in operation ever since (p. 4371, Qs34-36). The oil and acid consumption are set out at pages 4371 to 4375, Q37-Q58, and Plaintiff's Exhibits 247 and 248 (Vol. 9, pp. 5353-5354). The average for 1914 was .66 pounds of oil per ton of flotation feed and 10.7 pounds of acid; for 1915, 1.05 pounds of oil and 9.94 pounds of acid; for 1916, .70 pounds of oil and 10.19 pounds of acid.

The extent of use of the process in the zinc concentrator is set out at pages 4375-4379, Qs59-80, and in Plaintiff's Exhibit No. 249. The total ore tonnage treated in the zinc section up to the end of March, 1917, was 470,980 tons.

Plaintiff's Exhibit No. 249 (Vol. 9, p. 5355), produced and explained by Mr. Rossberg, shows the grade of flotation concentrate produced in this zinc section of the Timber Butte Mill as averaging, during January, February and March, 1917, 54.474 per cent. in zinc content, and the recovery by flotation expressed in percentage of zinc as 97.72 per cent. (figured as the ratio of zinc in the concentrate to zinc in the flotation feed), and the tailings that ran to waste as containing .714 per cent. of zinc.

The copper section of the Timber Butte mill is described by Mr. Rossberg at pages 4379-4381, Q81-Q84, in connection with the flow sheet, Plaintiff's Exhibit 250 (Vol. 9, p. 5356). It began operations in May, 1916, and has been in continuous operation ever since (p. 4381, Qs85, 86).

The total tonnage treated up through March, 1917, was 89,453 dry tons from the Colusa Parrot dump (p. 4381, Q87). The average amount of oil used during 1916 was 2.83 pounds per ton of flotation feed, and during the first three months of 1917, 2.28 pounds per ton (p. 2358, Qs88, 89). The acid used in 1916 averaged 9.38 pounds per ton, and for the three months of 1917, 5.87 pounds per ton (Q90).

The Colusa Parrot dump, which the copper section of the Timber Butte mine is treating, is a reject of former water concentration processes and contains approximately 900,000 tons, showing an average of 1.05% copper, which at the market price of 25 cents per pound for copper, represents a present net value, in view of the adaptability of flotation to treat it, of \$1,800,000 (pp. 4382, 4383, Qs95-102).

Mr. Chapman also testifies as to this installation (Vol. 7, pp. 4100, 4101, Qs42-45).

Maxwell W. Atwater.—Mr. Atwater is a licensee of the appellees, living in Basin, Montana, and applied the process in suit first to the Basin dump of the Butte & Superior Mining Co. (appellant) at that place, and later to a copper tailings dump at the same place. His testimony describing this work is found in Vol. 7, pp. 4126-4135.

The Basin dump of the Butte & Superior Copper Co. consisted of a remnant of about 50,000 to 60,000 tons, as treated by Mr. Atwater (pp. 4128, 4129, Q14). It was the reject or tailings from the water concentration processes that had been employed there by the appellant

for two years ending about May, 1912, in the treatment of some 300,000 tons of ore (Q13). These tailings were reground by Mr. Atwater and concentrated by flotation in a standard Minerals Separation machine and a sub-aeration cleaner machine, beginning in June, 1914, and continuing until the dump was exhausted. The grade of concentrate averaged better than 54% zinc, sometimes reaching over 57% for months at a time (Q25). The recovery was 90% or a little better (Q26). At first about six pounds of oleic acid was used and two to four pounds of sulphuric acid. Later turpentine and pine oils were employed in place of oleic acid and only one or two pounds, either mixed together or separate, and as high as 15 pounds of acid (Q29). The profit over and above all expenses averaged about \$45.00 per ton of concentrate (Q36).

To indicate the loss suffered by appellant prior to May, 1912, Mr. Atwater has made a calculation showing that if the entire 300,000 tons of ore which were treated at Basin by water concentration processes prior to May, 1912, had instead been treated by the flotation process as employed, and with results obtained by Mr. Atwater after June, 1914, the appellant would have made a profit of upwards of \$1,000,000 more on that ore than it did make (Vol. 7, pp. 4135-4138, Qs58-63, and Vol. 8, pp. 4668, 4669, Qs1, 2, and Plaintiff's Exhibit 274, Vol. 9, pp. 5441, 5442).

The copper tailings dump at Basin under treatment by Mr. Atwater, known as the Heinze dump, contains 60,000 to 80,000 tons (p. 4159, RQ226), having a copper content of 1.25% (p. 4133, Q39). This is being sub-

jected to plaintiff's flotation process with acid and heat, and about 3 pounds of oil mixture to the ton of ore (Q45). The recovery is about 90% (Q50) and the grade of concentrate about 9% copper (Q51), which is profitable (Q55) and is in fact slightly higher than the standard of the Anaconda Copper Mining Company, 8.07%, and is a desirable and profitable grade for the Montana copper region (Wiggin, Vol. 8, pp. 4303, 4304, Qs53, 54).

The Inspiration Consolidated Copper Company.—The mine and mill of this company are located in Miami, Arizona. It is one of the great porphyry companies. The facts are set out by Mr. Greninger at Vol. 7, p. 4046, Q27 et seq. After a six months' test from January to June, 1913, on a small 50-ton standard Minerals Separation plant, a larger 600-ton plant was built, beginning January, 1914 (p. 4048, Qs42-47). Out of this grew the present installation, which was commenced in 1915 (p. 4076, XQ248). There are at present nineteen sections in use, and a twentieth section nearing completion (p. 4049, Qs50-52) having a total capacity of about 18,000 tons of ore a day (Qs53, 54) or about 6,500,000 tons per year. The oil used is about one and a half pounds of a mixture of crude tar oil and cresol (p. 4055, Qs87-89). The original ore contains 1.54% copper (Q85). The recovery of the copper that is in the form of sulphide is over 90 per cent. (p. 4071, XQ205). A shaking table treatment follows after flotation (p. 4055, Q82, p. 4070, XQs197, 198), but the amount recovered in that way is only 2 or 3 per cent. of the total recovery (p. 4089, RQ327).

The flotation machines of four mill sections are Callow cells; one section has a Minerals Separation machine of the Hebbard (sub-aeration) type; the other fourteen sections are special machines of the Inspiration type (p. 4049, Q50). In all of these machines compressed air is forced into the pulp at the bottom. Other details are set out in cross-examination (p. 4064, XQ151, to p. 4084, XQ293), and in further cross-examination and redirect examination (p. 4086, XQ305, to p. 4089, RQ328).

Mr. Chapman assisted in this installation, and briefly outlines his connection with the work in corroboration of Mr. Greninger (pp. 4096-4098, Qs13-23).

Consolidated Arizona Smelting Co.—Mr. Chapman testifies as to an inspection of this plant wherein a standard Minerals Separation machine was operating on copper ore, using between 2 and 3 pounds per ton of ore of a frothing agent consisting of a mixture of Carolina turpentine (an essential oil), fuel oil and stove oil, with recoveries in the neighborhood of 80%, which have been considerably increased, and on his last visit in 1916 were 93 or 94% (pp. 4098-4100, Qs24-40).

Old Dominion Mining & Smelting Co.—Mr. Greninger briefly described this installation as first made in 1913 (pp. 4089-4091, Qs. 329-335). Here the material treated was absolute waste before the process of the patent in suit was installed (Qs333, 334). In 1916 Mr. Chapman visited this plant (p.4106, Q67) and found it in operation using the largest amount of frothing agent in Mr. Chapman's experience, a little over 7 pounds of frothing agent per ton of ore (p. 4107, Qs71-73). This

company had not paid any royalty up to the time of the trial, although its operations have been carried on over a considerable period of time, but having contracted to do so by license agreement and having installed and used the process in suit over a period of years, it certainly has afforded evidence of the value of the process in suit, even if it had not paid its debts up to the time of the trial. The evidence shows that although this Company has endeavored to escape its contract obligations (Plaintiff's Exhibit 291, letter of June 18, 1914, Old Dominion Co. to Minerals Separation, Ltd., Vol. 9, p. 5508) it has not been released (letter of July 1, 1914, from Minerals Separation, Ltd., to Old Dominion Co., p. 5509). An abstract of the license (p. 5507) with these letters annexed, appears in Plaintiffs' Exhibit 291 (pp. 5489-5517).

Atlas Mining & Milling Co.—Mr. Greninger describes this installation, made in the fall of 1913 (Vol. 7, pp. 4058, 4059, Qs102-110). Here the ore was a lead-silver ore containing about 2% of lead and 10 to 14 ozs. of silver per ton of ore. Crude carbolic acid was the principal frothing agent, used in the proportion of from 1 to 1½ pounds per ton of ore. The recoveries were 90% of the lead and 80% to 85% of the silver, the concentrates containing 20% of the lead and 100 ozs. of silver per ton of concentrate. It may be noted that if the carbolic acid had been pure and used alone, it would have been pure phenol, a soluble frothing agent, but evidently in its crude form and used with other frothing agents it involved the presence of an oily frothing agent.

Dutch Sweeney Mining Co.—This is a gold mine, with an ore assaying between \$3 and \$4 per ton (Chapman, Vol. 7, p. 4123, RQ170), and concentrates obtained are valued at nearly \$40 per ton (RQ172). They have a Minerals Separation sub-aeration machine (RQ169).

Other Licensees in the United States.—Mr. Chapman testifies to visiting the properties of the St. Joseph Lead Company, the Doe Run Lead Co., the Portland Gold Mining Co., the Vindicator Gold Mining Company, and the McDonald and Noble installation, at all of which flotation had been installed under the direction of the plaintiffs (Vol. 7, p. 4106, Q67).

**COMMERCIAL USE OF THE INVENTION—UNITED STATES—
INFRINGEMENTS.**

Chino Copper Co.—The facts as to the use of flotation by this Company at its plant in Hurley, New Mexico, are proved by the appellant. Mr. Wicks, Assistant Superintendent of the mills of this Company, describes the operations at length (Vol. 5, p. 2384 et seq.) and produces tabular statements said to set forth all of these operations. Defendant's Exhibit 29 (Vol. 9, p. 4990) is the final tabular statement of the plant treating vanner concentrates, and Defendant's Exhibit 125 (Vol. 9, p. 5141) is the final corrected tabular statement of the plant treating slime vanner tailings. The concentrates plant treated, from December, 1914, to March 31, 1917, a total of 223,775 tons of the finer low grade concentrates from water concentration, with an average recovery of about 94% and an average

increase in grade from 7.97% of copper to 29.62% of copper. The material treated was so fine that screen analysis did not show anything. 90% of it went through a 200 mesh screen (Vol. 5, p. 2430, Q71). The slimes plants treated 2,064,070 tons, with an average recovery of about 33% of the copper, and an average increase in grade from .804% copper to 25.35% copper. This material, the slimes reject of water concentration, was considerably finer than the vanner concentrates (p. 2442, Qs127-130) and evidently would be a waste product but for the process in suit. The low recovery was due to oxides and carbonates of copper which were not recovered by the process, and are ordinarily not recoverable by flotation (p. 2444, Qs136-141).

The slimes plant operated throughout this entire period with an average of 1.13 lbs. of oil per ton of ore or material treated, .056% of the ore. No change was made in this plant after the Supreme Court decision, and in the first quarter of 1917 the tonnage treated was 388,420, and the average oil per ton was 1.04 lbs., or .052%. A few experimental runs were made, however, with varying amounts of oil, at times more than a fraction of one per cent. of the ore, but these were of such small account that the average oil for the quarter was less than for the entire year 1916.

The smaller vanner concentrates plant with a yearly tonnage of only about 100,000 tons, as compared with a yearly tonnage of one and a quarter million tons of the slimes plant (see total tonnages of 1916 in Exhibits 29 and 125), was selected for demonstration of the possibility of operating a flotation plant with more oil than

a fraction of one per cent., and commencing December 21, 1916, the oil used averaged 23.38 pounds per ton of ore, 1.17% of the ore. The method of bringing this about was exceedingly simple. Before this change was made the oil used was a mixture containing 90% Barrett creosote (an impure material containing mineral-froth-producing oil and soluble frothing agent) and 10% Jones oil (a petroleum or fuel oil inert in the process in suit but useful in minute proportions with a soluble frothing agent). The mixture was changed to 10% Barrett creosote and 90% Jones oil (Vol. 5, pp. 2422, 2423, Qs41-44). From December 1 to 20, 1916, the oil mixture used averaged 12.39 pounds per ton, which contained 10% of inert oil. From December 21, 1917, to March 31, 1917, the oil mixture used averaged 23.38 pounds per ton and contained 90% of inert oil. The creosote in its impurities also included a fair amount of inert material and the net result undoubtedly was the use of about the same amount of mineral-froth-producing oil and soluble frothing agent at all times.

The fact that the material used at this mill which contains the mineral-froth-producing oil and the soluble frothing agent is a crude material containing a considerable proportion of impurities—a coal tar distillate from the well known roofing concern, the Barrett Company of Chicago (Wicks, Vol. 5, p. 2478, Qs288-291), would seem to account for occasional freakish operations at this mill, as for example the use on November 20, 1916, of 4500 lbs. of Barrett creosote (Vol. 6, p. 2940, Q27) in treating 179 tons of ore (Vol. 9, p. 5234), or 25.1 lbs. of creosote per ton of ore, when the average

total of all oils for the year 1916 was only 10.24 lbs. per ton and for the month of November, 1916, 13.71 lbs. per ton. But appellees' representatives were not present at any of the operations at this mill.

Janney Machines. The machines used were Janney machines, invented in 1913 and later (Janney, Vol. 5, pp. 2589, 2590, XQs217-224). These machines subject the pulp to a very violent agitation, much greater in degree than the standard machine of plaintiffs. Appellant's witness Conrads admits that this is "a terrific agitation" (Vol. 5, p. 2709, XQ387), and appellant's witness Wicks says that the pulp is so violently agitated that it is "almost a mist" in the agitating chamber (p. 2440, Q115). By reason of the excessive aeration resulting from this terrific agitation, this machine lends itself to masking the operations of the process in suit by moderate, and in emergencies immoderate, quantities of inert and useless oil. It is an interesting fact that this machine was invented by Mr. Thomas A. Janney, a capable metallurgist who has been active in the affairs of the Jackling group of mines (F. G. Janney, Vol. 8, pp. 4824, 4825, XQs49-52), including, with the appellant, the Chino Copper Company, the Ray Consolidated Copper Company, the Utah Copper Company and the Nevada Consolidated Copper Company (p. 4814, Q4), whose metallurgists have assisted the appellant, whose mills have been utilized for expensive tests and operations to aid the appellant, and all of whom are admittedly guilty of infringement of the patent in suit. This Janney machine is used by all of the infringers who assisted in the defense, as well as by the appellant.

The Janney machine is described by Mr. Wicks (Vol. 5, pp. 2437-2442) in connection with a very crude sketch, Defendant's Exhibit No. 27 (Vol. 9, p. 4988). The construction of the machine is much better shown in Mr. Janney's first issued patent No. 1,167,076, of January 4, 1916 (printed Vol. 9, pp. 4998-5004). Another patent to him, No. 1,201,053, issued October 10, 1916 (printed Vol. 9, pp. 5006-5014), shows his laboratory or test machine, which is in evidence, Defendant's Exhibit No. 185, and a drawing of which is in evidence, Defendant's Exhibit No. 183 (Vol. 9, p. 5226). Another and more recent type of this machine, referred to by the witnesses as the mechanical-air type, is substantially the same except that it contains in the spitzkasten a false bottom with an air cell covered by a porous medium so that aeration resulting from the terrific agitation is supplemented by subaeration, with its accompanying agitation, in the spitzkasten (pp. 2440, 2441, Qs121-124). Both types of machine are used by all of the mines of the Jackling group above referred to, including the appellant.

Utah Copper Company—Arthur Mill. The facts are stated by Mr. Thomas A. Janney, superintendent of the Mill (Vol. 5, p. 2542, et seq.) and the operations of one of the flotation plants at this mill, called the retreatment plant because it treats a low-grade vanner concentrate, are shown in Defendant's Exhibit 30 (Vol. 9, p. 4992). It appears that after about two years of experimental investigation, beginning in 1913, the Utah Copper Company, at its Arthur Mill, adopted flotation on a commercial scale, commencing in February, 1915,

and from that time up to December 21, 1916, it treated in this retreatment plant 420,285 tons of low-grade concentrate of an average of about 7% copper and obtained high-grade concentrates of an average of about 27% copper, using oil in a proportion averaging 3.76 lbs. per ton of ore or material treated, .19%. On December 21, 1916, this particular plant was changed over to use larger quantities of oil. For ten days to and including December 31, 1916, the amount of oil used was 23.95 lbs. per ton, 1.2%. In January, 1917, it dropped to 19.73 lbs. per ton, or .99%, and in February and March, 1917, it dropped to 15.39 and 15.33 lbs. per ton, respectively, an average of .77%. The regular operations reported stopped during March. From March 25 to April 8 experiments were carried on with the employment for the greater part of the time of an unusually large and wasteful amount of oil, and in a few experiments of an insufficient amount of oil, the average for these days being 39.13 lbs. per ton, or 1.96%. These experiments produced a very material impairment of the operations, and the great loss in the tailings is explained by a footnote as due to "extensive experimenting with oils." The average for the entire period from December 22 to April 8, was 18.81 lbs. per ton, or 94%, and the average of the regular operations very much lower. It thus became impossible in this selected plant at this mill to carry on the process of the patent in suit with one per cent. or more of oil, and coincidentally with the drop in January, 1917, to a fraction of one per cent. of oil, a method of calculation was hit upon for the purpose of increasing the figures alleged to represent the amount of oil used. Oil which

had already been used in the process and was returned with an unfinished concentrate or middling, was denominated as circulating oil and added to the oil actually used in the process, and the result was called "total oil," and this in January raised the average figure to 20.75 lbs. per ton, or 1.04%. In February, even this method of calculation failed to bring the figure up to 20 lbs. per ton or 1%, the actual figure being 18.30 lbs. per ton or .91%. In March the average of this so-called total oil was 20.26 lbs. or 1.01%. This method of calculation is considered under the heading "Infringement—Circulating Middlings."

There is also at this Arthur Mill a much larger flotation plant for the treatment of vanner slimes, the very fine reject of the water concentration of the mill. Mr. Janney describes this material as "very fine slime" (Vol. 5, p. 2571, Q129) 75% of which will pass through a 200 mesh screen (Q128), and it appears that it is of only about 1% copper content (Vol. 9, p. 5244). This plant is so large that to operate it at 20 lbs. of oil to the ton of ore would require 10,000 gallons of oil per day (p. 2578, Q171), whereas the retreatment plant requires under like conditions only 1500 gallons per day (Q174). The flow sheet of this plant was demanded and obtained (Vol. 8, p. 3844, Qs119, 120; Vol. 9, p. 5280) and is described (pp. 3844-3846). This flotation plant was being operated at the time of the trial without waste of oil, the oil used being in the proportion of 1.4 lbs. per ton of ore, .07%, and with recoveries of about 90% (Vol. 5, p. 2610, XQs332-336; p. 2572, Q133). The cost of wasting oil in operating this large plant was evidently prohibitive.

Thus we find that at this Arthur Mill the most strenuous efforts had failed to produce any regular operations in any of the flotation plants employing more oil than a fraction of one per cent. of the ore or material treated.

The experimental runs above referred to were carried on under such conditions that no one can tell just what relative proportions of soluble frothing agents were present, the one certain fact being that soluble frothing agents were always present. The experimental runs in the retreatment plant are reported in Defendant's Exhibit 31 (Vol. 9, pp. 4994, 4995). As to experiment No. 1 (run on March 30; Vol. 5, p. 2557, Q64) the amount of oil mixture fed was 1.60 pounds per ton of feed. But the pulp was fed from vast reservoirs to which had been returned the middlings of the run of the preceding day (Experiment 2, March 29; p. 2590, XQ225), during which 3.75 pounds per ton of oil mixture had been fed to the pulp; and the middlings came back with 41.4 pounds of an oil mixture, not analyzed, but only determined in bulk, per ton of circulating middlings, as is determinable by simple calculation from the total circulating middlings and the total oil therein. Mr. Janney admits that the contents of the two reservoirs or Dorr tanks which receive both new feed and circulating middlings and from which all the pulp fed to the flotation plants, is "something enormous" and that as they "operate from day to day these tanks or these two tanks become contaminated or contained so much oil that is carried over from the day before" (Vol. 5, pp. 2620, 2621, XQ401).

The especial significance of these facts is as to the certain presence in the pulp of a large amount of soluble frothing agent. The oily mineral-frothing agent of the process in suit is attached to and goes with the metallic particles, wherever they go, mainly, of course, to the concentrate. The soluble frothing agent, on the other hand, stays in solution, as Mr. Higgins testifies, comparing the oily frothing agent of the process in suit, with the soluble frothing agent of patent 962,678.

“That oil is found at the end of the operation on the concentrate chiefly. A very small portion may be found in the tailings, but the water is particularly free from it and [it] is no longer useful as a frothing agent. That makes a big contrast in the solution patent where the frothing agent remains in the solution and the solution can be used over again usefully” (Vol. 8, pp. 4602, 4603, Q403).

One of these experiments, No. 20, is put forward and described as having been made with petroleum oils exclusively (Janney, Vol. 5, pp. 2565, 2566, Q101-103). This experimental run was made on April 7 (p. 2591, XQ228-229). During the two preceding days, April 5 and 6 (Experiments 15, 16, 17; p. 2591, XQ225-227), the plant had been run exclusively with creosote and pine oil, both containing soluble frothing agents (as well as mineral-froth-producing oils). Obviously the pulp contained a large amount of soluble frothing agents which dominated the operation.

These experiments were not made in the presence of appellee's representatives. The only experiments made in behalf of appellant with petroleum in appellee's presence, were those made in court, and as to those it

was proved that the petroleum oils were contaminated with soluble frothing agents. When appellee visited appellant's plant, no attempt was made to show the effects of petroleum alone.

Utah Copper Company—Magna Mill. The facts as to the operations of one of the flotation plants at this mill, the retreatment plant, are set out by Mr. Conrads, metallurgical engineer at this mill (Vol. 5, p. 2629 et seq.) and figures up to and including December 24, 1916, are given in Defendant's Exhibit 35 (Vol. 9, p. 5015). It appears that the use of the process in suit began in this mill in September, 1914, and that in the period of two years and nearly four months covered by Exhibit 35, 568,163 tons of very fine low grade concentrates of water concentration were treated. The oil averaged 3.79 lbs. per ton of ore, or .19% of the ore. The concentrate was raised from the average grade of 8.35% copper to 21.01% of copper. The indicated recoveries averaged 97.46%. These operations were therefore highly satisfactory. On December 24, 1916, however, the amount of oil was increased (D. Ex. 36, Vol. 9, p. 5016), and during the remainder of that month averaged 15.93 lbs. per ton of ore, .8%. This failed of the goal of the effort, and during January the average was slightly increased to 18.41 lbs. per ton, or .92%, which still failed of the goal. During this month, however, the new method of calculation, which included oil already used with the oil added, by measuring the amount of oil in the circulating middling or unfinished concentrate, was adopted, and this brought the so-called total oil up to 22.01 lbs. per ton, 1.1%. In Feb-

ruary, 1917, the amount of oil actually used was diminished to 11.32 lbs. per ton, .57%, but by adding the already used oil in the circulating middlings, the so-called total was brought up to 23.21 lbs. per ton, 1.16%. In March careful watching produced the desired average of so-called total oil 20.62 lbs. per ton, 1.03%, although to accomplish this the new oil, or oil actually used, had to be increased to 14.88 pounds per ton, .74%. In April the seven days shown in the table were largely given over to experiments with consequent large losses in the tailings, and here the average of oil actually used was 14.81 lbs., .74%, and the so-called total oil only 16.08 lbs., .8%. The average of all of the oil wasting operations was 15 lbs. of oil to the ton, .75%. The operations exhibit a careful and futile effort to avoid using an amount of oil which does not exceed a fraction of one per cent. on the ore.

Tables of daily operations commencing December 25, 1916, were demanded and obtained, Defendant's Exhibits 39-43 (Vol. 9, pp. 5022, 5024, 5026, 5028, 5030), and these show that an oil mixture was used during December and early January containing 95% of Jones oil (a fuel petroleum inert in the process of the patent in suit) and 5% of pine oil (a combination of mineral-froth-producing oil and soluble frothing agent) followed by increase of the inert oil to 97% and diminution of the active frothing agents to 3%, and numerous struggles with oil mixtures, resulting finally in the latter part of March in a mixture containing 87½% of inert petroleums and 12½% of creosote, the latter containing mineral-froth-producing oil and soluble frothing agent and useless impurities.

At this Magna Mill there is also a slimes flotation plant, installed by Mr. Thomas A. Janney in the latter part of 1914 (Vol. 5, p. 2571, Q130). The amount of oil used in this plant during 1914 was in the neighborhood of from 1 to 5 lbs. per ton of ore (Qs131, 132). In April, 1916, it was found that by sulphonating the active frothing oils creosote and pine oil, excellent results could be obtained (p. 2572, Q133). Nothing further appears about this plant except the statement of Mr. Janney that if all the flotation plants at the Arthur and Magna Mills were changed over so as to use 20 lbs. of oil per ton of ore, it would require 87,500 gallons of oil per day (Vol. 5, pp. 2578, 2579, Q175). He also says that for the retreatment plants the particulars of the operations of which are given, it would require about 1500 gallons per day at each plant (Q174), and that for the slimes plant at the Arthur Mill it would require 10,000 gallons of oil per day (Q171). These figures leave an amount of 74,500 gallons of oil per day as required for operating the slimes plant at the Magna Mill for the oil-wasting conditions of the use of 20 lbs. of oil to the ton of ore. This slimes plant therefore is the greatest of all the flotation plants of the Utah Copper Company, and the expense of wasting oil in it being prohibitive, it was evidently not altered or experimented with in this direction. Indeed, it is quite obvious that it is not practicable to operate these great slimes flotation plants at these two mills with a waste of oil.

One other point of interest in these oil-wasting operations is very striking with the arrangement of flota-

tion machines used in the so-called retreatment plants at the mills of the Utah Copper Company, and is true to some extent as to all of the oil-wasting operations. This is the arrangement of flotation machines in series, so that each subsequent machine after the first machine operates upon a pulp mixture in which the proportion of oil to material treated is constantly diminishing. In the Magna Mill there are seventeen flotation machines in series, each subsequent machine receiving the tailings of the preceding machine (Flow Sheet, Plffs. Ex. 245, Vol. 9, p. 5347). The first machine produces a floating product in its spitzkasten which, in oil-wasting operations, contains an enormous proportion of oil, and this product, mixed with that of the other spitzkastens which produce finished concentrate, goes out of the system. Thus a great amount of oil is ejected from the system in the first operation of agitation and flotation, and each succeeding operation ejects oil. This was discovered by appellees' representatives at an exhibition of this particular flotation plant, during the trial, and is established by appellant's assays. Each successive machine down the line operates upon tailings containing a smaller proportion of oil than the material operated upon by the preceding machine, and the oil proportion is stepped down from machine to machine of the seventeen machines in series. This was admitted by Mr. Conrads at an early stage of the testimony (Vol. 5, pp. 2709-2714, XQs381-415), and later the machine was exhibited and the actual assays of the products, as proved by the defendant, showed that with the use of 21.32 lbs. of oil to the ton of ore, the overflow of the first spitzkasten contained 412.31 lbs. of oil per ton of prod-

uct, the overflow of the second spitzkasten 96.75 lbs. of oil per ton of product (Vol. 9, p. 5358), of the third spitzkasten 55.72 lbs. of oil per ton, of the fourth 28.72 lbs. of oil per ton, of the fifth 16.39 lbs. of oil per ton (p. 5359), and the combined sample of spitzkastens 1-10, 46.88 lbs. of oil per ton of product (p. 5361). The tailings fed from machine No. 11 to be operated upon in machine No. 12 contained only 6.60 lbs. of oil per ton of product, .33%, and the tailings fed from machine No. 11 to machine No. 12 contained only 5.75 lbs. of oil per ton of product, .29%. The original oil proportion of 21.32 lbs. of oil, or 1.08% must have been diminished to a fraction of one per cent. in the first machine, with its overflow containing 412.31 pounds of oil to the ton of product. The remaining sixteen machines were undoubtedly treating a product containing only a fraction of one per cent. of oil.

In the Arthur Mill retreatment plants there is this same arrangement of a great number of machines in series with the overflow of the earlier spitzkastens ejected from the system, the second machine treating the depleted product of the first, and so on (Flow Sheet, Vol. 9, p. 5278). One set of machines has 13 machines or cells in series and the other 15 machines or cells in series. Thus these retreatment plants were peculiarly well adapted for performing experiments with large amounts of oil initially used, but the excess speedily ejected from the systems.

An experimental run typical of other similar runs by defendant's allies, was carried on at this mill for the expressed purpose of demonstrating that better

results can be obtained with more than one per cent. of oil than with less than one per cent. of oil. This character of evidence is not now of any importance, since appellant admits that its operations with one per cent or more of oil are metallurgically inferior and financially disastrous, and asks to be permitted to continue them for that reason. Nevertheless, in this instance the experiments will be considered. They are tabulated in defendant's exhibit 38 (Vol. 9, p. 5020).

An oil mixture which with variations of degree and not of kind, in three months' operations averaged 22.18 pounds to the ton of ore, was used in diminishing proportions down to 4.16 pounds per ton of ore, with diminishing recoveries, shown in the table as an increase in the amount of copper in the tailings. These losses are elaborated at various prices of copper.

The fact is that this oil mixture had to be present in about this proportion of 22.18 pounds to the ton of ore, in order that there should be present the necessary and critical amount of mineral-froth-producing oil and soluble frothing agent. The mixture used was 87½ per cent fuel oil (inert) and twelve and one-half per cent of creosote (containing mineral-froth-producing oil and soluble frothing agent). The 22.18 pounds of this mixture contained 2.77 pounds of creosote. When the proportion of the mixture was reduced to 4.16 pounds, the amount of creosote present was reduced to .52 pounds, only a little more than one-half a pound. The table of operations up to December 24, 1916, (Vol. 9, p. 5015) shows the former to be about the average used throughout this period of two years, allowing for the

very small amount of petroleum present. The reduction, therefore, in the amount of creosote, impaired the operation, and this would have been true whether the inert petroleum was present or absent. The elaborate calculation of losses is meaningless, and the table demonstrates nothing except the unreliable character of appellant's evidence.

Ray Consolidated Copper Co.—The facts are stated by Mr. Engelmann, flotation foreman of the Company, as a witness for appellant (Vol. 5, p. 2732 et seq., Vol. 6, p. 3234 et seq.) and the operations are shown in tabular statements, Defendant's Exhibit 150, Retreatment plant (Vol. 9, p. 5166) and Defendant's Exhibit 151, Tailings Plant (p. 5167). It appears from Exhibit 150 that flotation operations on the retreatment of vanner concentrates began during the fourth quarter of 1914, and continued up to the trial, during which time about 379,651 tons of material were treated, and that the oil employed was between 4 and 5 lbs. per ton in 1914 and 1915, between 3 and 4 lbs. per ton in 1916, and, in 1917, 20.02 lbs. per ton in January (1.001%), 18.77 lbs. per ton in February (.94%) and 21.19 lbs. per ton in March (1.06%) the average for the three months being 20.1 lbs. or 1.05%.

Here also, when, during January, 1917, the oil used hovered so close to one per cent. as to show that it would have to be dropped below one per cent., as occurred in February, the expedient of adding used oil to new oil was adopted, and in February this gave a figure of 1.07%, or 21.4 lbs. per ton, but strangely in March this expedient reduced the given total figure to

.97%, 19.4 lbs. per ton. The figures based on circulating middlings are, however, altogether deceptive and unworthy of consideration. It is noted that an expert oil chemist was employed to determine the amount of oil in the circulating load or circulating middlings, who spent something more than two months on the problem (p. 2744, Q54).

The same change in oil mixtures was made in this mill as in the other infringing mills, when changing to oil-wasting operations. Before 1917 the mixture contained 75% of creosote, with its useful frothing agents, and 25% of fuel oil, a petroleum, not a frothing agent, and useful only in minute proportions when the process of the soluble frothing agents patent No. 962,678 is carried on. Creosote contains a soluble frothing agent, and this minute proportion of fuel oil, less than a pound to the ton of ore, probably performed the only useful function that it can perform in flotation, of assisting in the stabilizing of the froth produced with a soluble frothing agent. When the change was made to larger oil proportions the mixture was changed to 10% of creosote and 90% of fuel oil (Vol. 6, p. 3244, Q37). Thus was added a wasteful, useless amount of an oil inert in the process in suit. From less than a pound it became about 9 lbs., while the creosote, which contained the mineral-froth-producing oil and which during 1916 was present in the proportion of about 2½ lbs. per ton (75% of 3.36) was now present in the proportion of about 2 lbs. (10% of 20). So far as the process in suit is concerned, the operation was substantially the same before January 1, 1917, as after

that date. So far as the process of the soluble frothing agents patent is concerned, the soluble frothing agent was present in about the same proportion before and after January 1, 1917, but the minute amount of inert and non-frothing oil which had helped it before January 1, 1917, was changed into an unconscionable and wasteful amount which impaired the process as a whole but did not destroy it.

The other flotation plant at this mill, that for treating the slime tailings, deals with a product which admittedly went to waste before flotation was installed (Engelmann, Vol. 6, p. 3269, Qs139-141). Its operations, commencing with the second quarter of 1915 and up to the end of 1916, are shown in Defendant's Exhibit No. 151 (Vol. 9, p. 5167). A total of 1,998,088 tons of this formerly waste product was treated in 1916 and the average amount of oil used was .85 lbs. per ton of ore, .04%. These operations have continued with the "usual amount of oil" (p. 3261, XQs87-88). This plant treats 7000 tons of material a day (p. 3235 Q8), and evidently the cost of wasting oil in it was prohibitive, whereas the retreatment plant only treats 350 tons per day (*idem*) and the waste and injury to operations was not so serious. All that the table shows of the operations of this great plant during 1917 are a few experiments with portions of the plant, as described in the footnote to the table. The earlier of these experiments were with straight coal tar, a mixed product which appears to possess the same character of constituents as the mixture of 90% of petroleum fuel oil and 10% of creosote which was used at other times in these

larger oil operations. It is interesting that the operations from February 8 to March 14 were obtained in the air machine (pneumatic or Callow type) annex of the mill, sketched in Defendant's Exhibit No. 149 (Vol. 9, p. 5165). On February 18, 1917, the amount of coal tar used was exactly 20 lbs. to the ton of ore (Vol. 6, p. 3268, XQ134) and on the other days of this run the oil at times went above 20 lbs., and at times below 20 pounds. (XQ135), the average of the run from February 8 to 28 being 20.1 lbs. of coal tar per ton of ore.

It may be noted as to all of these operations of the infringers who are assisting the appellant, in so far as they have been disclosed, that they demonstrate that with mixtures of mineral-froth-producing oils, of soluble frothing agents, and of inert oils, such as were invariably used, there is no one per cent. barrier.

Mr. Engelmann frankly admits that an effort was made to operate at his plants on straight fuel oil at various times.

"but we could never maintain metallurgical results" (Vol. 6, p. 3255, Q78).

This is equally true as to all operations, although efforts were made by others of appellant's witnesses to mask their operations and hide the fact that a soluble frothing agent was always present whether dissolved in the pulp or water returned and stored from operations of preceding days or fed into the pulp during the experimental runs.

Nevada Consolidated Copper Co.—The operations of this member of the Jackling group of mines were not

put forward in this case by the appellant, but were extracted in cross-examination from Mr. Frank G. Janney (Vol. 8, pp. 4825, 4826, XQs53-59; p. 4827, XQs66-68). It appears that this company was infringing the process in suit in 1914, using from $2\frac{1}{2}$ to 3 lbs. of oil per ton of ore, in Janney machines, and that it employed both soluble frothing agents and insoluble oily mineral-frothing agents.

Infringement—The Facts.

The procedure in defendant's mill covers three periods.

First, the procedure involved as the infringement in the Hyde case (August, 1911),

Secondly, the procedure from that date to January 7, 1917, and

Thirdly, the procedure from January 9, 1917, to April 15, 1917.

The first procedure has been held by the Supreme Court to be a clear infringement.

The second procedure is admitted by appellant's counsel here to be an infringement.

The third procedure raises the only issue of infringement that is made.

The facts as to these three procedures are briefly these:

1. In August, 1911, oil and acid and heat were used and vigorous agitation. The oil was oleic acid and 3.2

lbs. of it (.16%) per ton of ore was used; also about 1 lb. of sulphuric acid; and a moderate heat.

2. From August, 1911, to January 7, 1917, the procedure, with many variations, always included oil, and acid, and heat, and vigorous agitation.

The oil at first was oleic acid alone. Later it was usually a mixture of oleic acid and pine oil (June 1913 to about December, 1914). Through 1915 and 1916 it was usually pine oil alone.

The amount of oleic acid when used alone, or of the pine oil when used alone, or of the mixture when both were used, varied, but apparently was never above 4.24 lbs. per ton of ore (.21%). In July, 1913, 4.24 lbs. of a half and half mixture was used, i. e. .21% on the ore (Vol. 6, p. 3443, XQ. 443); in September, 1913, 2.799 lbs., i. e. .15% (Vol. 6, p. 3442, XQ. 440). In December, 1914, when pine oil was used alone it averaged for the month 1.64 lbs. per ton, i. e. .082% on the ore (Vol. 6, p. 3444, XQ. 450, 451). In 1915 it averaged 1.49 lbs. and in 1916 1.43 lbs., i. e. .07% on the ore (Vol. 9, p. 5184).

The acid varied considerably, being as high as 12 lbs. per ton in 1914. In 1915 it averaged 7.81 lbs. and in 1916, 5.25 lbs. The heating was maintained as before. The agitation was increased in vigor and violence with the introduction of the Janney machines, the use of which began early in 1915 (Vol. 6, pp. 3365, 3392, 3393, 3394).

A peculiarity in appellant's ore made the use of considerable quantities of sulphate of copper ap-

parently necessary to prevent defeat of the bubble formation by evolved sulphuretted hydrogen.

In 1916 the process of the patent in suit was used at greatest advantage. When the operations were thus most successful, pine oil was used alone, and in the smallest quantity ever used by appellant. Pine oil is itself a mixture, and contains both oil constituents and soluble constituents, and each character of constituent is separately an efficient frothing agent for the purpose of flotation, and both together are remarkably efficient. Thus the appellant, in using pine oil, was carrying on both the process of the patent in suit and the process of the 1910 patent No. 962,678 (Vol. 8, p. 4737, Q. 37½; p. 4702, Q. 57, 58).

This procedure, conducted from August, 1911, to and through 1916, appellant admits to be an infringement.

3. Then the Supreme Court decision came down, and after mill tests on small tonnages from December 29, 1916, to January 8, 1917 (p. 5197), on mixtures consisting largely of kerosene, Jones' crude oil and creosotes, and in most of which pine oil was omitted (p. 5199), and where large quantities of the mixture were added, running up to 63.03 lbs. per ton of ore (3.16%), in one case, appellant made the following changes *in its regular mill procedure*:

(a) Appellant doubled the sulphuric acid. In 1916, 5.25 lbs. had been used per ton of ore. This was increased to about 20 lbs. for a week, and then reduced to 13 lbs. or 14 lbs. and finally to about 10 lbs.

(b) Appellant increased the pine oil. In 1916 1.43 lbs. had been used per ton of ore (.07%). In the 19 days of January, 1917, when used at all, 1.51 lbs. were used on the average per ton of ore (.075%); in February, 1.90 lbs. (.095%), and in March 2.82 lbs. (.141%). These figures are actual and are obtained by calculation from Vol. 9, pp. 5189, 5185, 5187, 5193 and 5195. For example, the oil mixture used on January 31, 1917, was No. 18 (p. 5187, last column). No. 18 was 10% pine oil (p. 5189). The total oil mixture added per ton of ore to flotation was on January 31, 1917, 12.63 lbs. (p. 5187). 10% of that is 1.263 lbs., which is .063% on the ore. So each day was calculated and the average taken.

(c) Appellant added kerosene or fuel oil or Jones crude oil or mixtures thereof, aggregating on the average 11.93 lbs. in January, 1917, 16.25 lbs. in February and 18.77 lbs. in March per ton of ore.

The figures given in (b) and (c) disregard the creosotes and other ingredients used, but these constituted approximately only 10% of the whole in January, 5% in February and 2% in March.*

*Appellant has made it difficult to reach these separate values given in (b) and (c) above by its method of stating in Exhibits 158, 159, 161 and 162 only one figure for the total oil mixture added, including under that term kerosene, Jones crude, No. 1 creosote, No. 2 creosote, Fuel, Pine, No. 4 Barrett, Tar and Paraffine base. The ingredients and percentages of each mixture for each day are given however in Exhibit 160 (Vol. 9, p. 5189) and these percentages have to be figured on the total "Pounds Added" of the other exhibits. The above figures were obtained in that way. The figures given by Dosenbach as "the best illustration of the procedure at the mill" (Vol. 6, p. 3344, Q. 136, 137), namely, 30 lbs. of total oil mixture (1.5% on the ore) of which 5.40 lbs. was pine oil (.27% on the ore) and 24.60 lbs. was petroleum products; also the total of 26 lbs. (1.3% on the ore) of oil mixture used in appellant's mill demonstration made for appellees on April 29, 1917, of which 6.24 lbs. was pine oil (.312% on the ore) and 19.76 lbs. was petroleum products (Vol. 8, p.

Do these changes achieve non-infringement?

1. *The Discontinuance of the Use of Oleic Acid in December, 1914.*

This can only affect the question of infringement of claims 5, 6 and 7, which call specifically for oleic acid. Those claims have not been infringed since that time.

2. *The Addition of an Extra Quantity of Sulphuric Acid to the Pulp, 10 Lbs. Per Ton of Ore Instead of 5.25 Lbs.*

The necessity for the doubling of the acid evidences a greater tendency of the gangue to be coated with oil, for according to the patent (p. 1, line 41) the effect of acidity is "to prevent gangue from being coated with oily substance, or, in other words, to render the selective action of the oil more marked." The increase in the quantity of acid, therefore, would seem to be calculated not to change the process but to preserve it from change.

4431); also the total of 42 lbs. (2.11% on the ore) of oil mixture used on May 5, 1917, in the Exhibit Model Pyramid machine of which 7.56 lbs. was pine oil (.378% on the ore) and 34.44 lbs. was petroleum products (Vol. 7, pp. 3900, 3902)—all of these figures are seen by the actual figures later given of the real mill operations (D. Exs. 158, 159, 161 and 162) to be altogether too high in both factors.

These latter Exhibits disclose almost daily and startling variations of ingredients and of percentages and of totals. Thus the total oil mixture added per ton of ore varied in January, 1917 (p. 5187) from 8.06 lbs. to 22.55 lbs. and averaged 14.75 lbs.; in February (p. 5193) from 10.77 lbs. to 24.86 lbs. and averaged 19.33 lbs.; in March (p. 5195) from 17.52 lbs. to 29.44 and averaged 22.08 lbs.; and in April 1-15 (p. 5185) averaged 23.91 lbs. This covers all of appellant's operations from January 9 to April 15, 1917, and shows that neither 42 lbs. nor 30 lbs. nor 26 lbs. were typical of the total mixture added in the real mill operations. Nor were 7.56 lbs., nor 6.24 lbs., nor 5.40 lbs. typical of the amount of pine oil used in the actual mill operations.

Appellant gave no data for April from which corresponding calculations could be made. The court below adopted the larger figures first given by defendant's witnesses, the ones most favorable to it, and still found infringement.

3. *The Addition of an Extra Quantity of Pine Oil—1.51 Lbs. Per Ton of Ore in January, 1917 (.075%), 1.90 Lbs. in February (.095%) and 2.82 Lbs. in March (.14%) Instead of the 1.43 Lbs. Used in 1916 (.07%).*

This larger amount is well within the narrowest prescription of the patent, even when its soluble constituent is unsubtracted and disregarded. It is undoubtedly "considerably reduced" (p. 1, line 29) as compared to Cattermole proportions, and is reduced "say to a fraction of one per cent. on the ore" (p. 1, line 30), and is but little away from the "0.1 per cent. of the ore" which is given as the recommended proportion in the case of oleic acid and Broken Hill ore (p. 1, line 99). It is well within the terms of all the claims even on the narrowest construction—"a fraction of one per cent. on the ore" of claims 1, 2, 3 and 12—"a small quantity" of claims 9, 10 and 11 as limited by disclaimer. When the soluble constituent (which is dissolved out of the pine oil at once by the water of the pulp) is considered and subtracted the oil residue left to effect the process in suit must be less in quantity than the small quantities given.

Does the slightly larger quantity of pine oil operate in the process since January 9, 1917, any differently than the smaller quantity did before that time? No testimony for appellant shows that it operates any differently and no testimony even tends in that direction. On the contrary the experts on both sides agree that the same operation proceeds and the same mineral-carrying froth concentrate is produced, and

appellant's witnesses give no different explanation of its formation, and there is none.

The fact that after experimental efforts to do without pine oil its use had to be resumed (pp. 5197, 5199 and 5187 and 5189) indicates the essential character of its function in the process.

The fact that, coincidently with the addition of the excess quantity of petroleum products the quantity of pine oil had to be increased indicates that the fulfilling of its function in the process was rendered harder by the presence of the petroleum products. The function of the oil of the patent being to modify the air bubble formation and the adherence of "such bubbles or air films" "to the mineral particles" and thereby to effectuate the peculiar mineral-carrying froth phenomenon and result (patent p. 1, line 89, p. 2, line 111, p. 3, line 27), the inference to be drawn from the necessity of increasing the quantity of pine oil is, that the petroleum products, as used, tend to hinder and prevent that function.

The increase in the quantity of pine oil, therefore, would seem to be calculated not to change the process but to preserve it from change.

4. *The Addition of Kerosene or of Jones Crude Oil or of Fuel Oil, or of Mixtures Thereof in an Average Aggregate in January, 1917, of 11.93 Lbs., in February of 16.25 Lbs., and in March of 18.77 Lbs. Per Ton of Ore.*

The testimony on the question whether this addition of petroleum products changes the character or

the substance of the operation or the kind or nature of the result or product is as follows:

The appellees' testimony shows by Mr. Greninger (accepting the mill procedure of April 29, 1917, as illustrative of the process) that the froth of appellant's 1917 process

“was a mineral froth, I would say a typical froth of the patent in suit, with indications of a degree of over-oiling” (Vol. 8, p. 4326, Q. 14);

that the process is the process of the patent in suit (p. 4327, Q. 19, 20); that the result is the same (Q. 21) though inferior (Q. 22); that a large proportion of the oil of the mixture was an inactive oil and useless for flotation purposes when used alone (p. 4358, Q. 189-194; p. 4331, Q. 37-44); that much of it was absorbed by the clay slime of the gangue (Q. 32, 33).

Mr. Chapman testified on the same subject, beginning at Vol 8, p. 4430, Q. 2. He says that the process is the agitation froth process (Q. 37); that fuel oil, kerosene and stove oil are inactive in appellee's process (Q. 38-40), although in small quantities they help steady the froth overflow; he noted an unusually large proportion of clay gangue slime in the appellant's pulp (Q. 25), and says that this absorbs oil and renders it inactive for flotation purposes (p. 4433, Q. 27-29; p. 4450, XQ. 95, 96); he says that the agitation was greater than in appellees' standard practice (p. 4445, Q. 72).

Mr. Higgins testifies that the appellant's process as exemplified on April 29 was not the process of Everson, Kirby, Froment or the California Journal

(Vol. 8, p. 4739, Q. 43 et seq., p. 4782, RDQ. 249); that it was the process of the patent in suit (p. 4735, Q. 34-36), and that it was also the process of the soluble frothing agent patent (p. 4737, Q. 37, 38); that kerosene used alone is inert to flotation (p. 4740, Q. 49); and he demonstrated that fact by a court test employing 2 lbs. kerosene (.1%) per ton of ore (p. 4603, Q. 407-416). He then added 2 lbs. of pine oil per ton of ore (.1%) and repeated the agitation and a good mineral froth was produced (Q. 416-419). He testified that kerosene when used *in small quantities* with pine oil

“stabilizes the froth and prevents what we call showering, that is, the dropping out of the coarser particles from the froth” (p. 4605, Q. 419-422);

and he also demonstrated that the fuel oil and kerosene components of defendant's mixture, aggregating 18 lbs. to the ton, would not produce a mineral froth, but that when 4 lbs. of pine oil was added and the agitation repeated a good mineral froth was produced (p. 4606, Q. 424-426; p. 4611, Q. 444-447; p. 4613, Q. 458-466).

Mr. Wiggin of the Anaconda Co. says some of the petroleum oils do not produce the result aimed at in flotation (Vol. 8, p. 4315, XQ. 99); that he never considered stove oil a flotation oil (Vol. 8, p. 4316, XQ. 106); that stove oil seems to make the froth a little more compact (Vol. 8, p. 4283); that aluminous clay material in the Anaconda copper slime probably absorbs some oil, rendering that much of the oil useless for flotation (Vol. 8, p. 4300, Q. 33).

Some of appellant's witnesses attempted to prove sporadic operations with kerosene or fuel oil, but they were thoroughly discredited. (See cross-examination of Janney, Vol. 5, p. 2612, XQs. 349-408, and p. 2627, RXQs. 432-446). Appellant's brief, p. 45, italicizes the words *kerosene* and *alone* in the phrase "*kerosene acid sludge alone*" as though the Anaconda Co. used kerosene alone for flotation sometimes. But kerosene acid sludge is a by-product from the manufacture of kerosene. It is not kerosene and contains no kerosene (Vol. 8, p. 4317, Qs. 110-112).

Appellant's witness, Mr. Engelmann of the Ray Consolidated Co. says of fuel oil like that which constitutes about 70% of appellant's mixture,

"We tried at different times to run on straight fuel oil, but we could never maintain metallurgical results" (Vol. 6, p. 3255, Q. 78).

Professor Bancroft, testifying for appellant, repeatedly says that kerosene is a non-frothing oil, and selects it as the typical non-frothing oil (Vol. 6, p. 3145, Q. 24; p. 3153, Q. 50; p. 3154, Q. 51) and refers to the Appellant's mixture used on April 29 as containing (1) the non-frothing viscous oil, fuel oil, (2) kerosene, which he had selected as the typical non-frothing oil, and (3) pine oil, a frothing oil (Vol. 6, p. 3149, Q. 40, 41).

Dr. Sadtler, for appellant, says that in his experience some kerosenes cannot be made to raise a froth, while other kerosenes do, but he cannot say why (Vol. 8, p. 4790, Q. 6).

Professor Taggart, testifying for appellant, said that the oil that is not taken up by the bubble surfaces but on the contrary floats as oil, is

“lost to the process” (Vol. 6, p. 3024, Q. 248);

also that the oil that comes to the surface as oil and flows over with the concentrate is wasted (ib.). Appellees’ witnesses had spoken of the appearance of oil floating as oil in the froth concentrate on April 29.

Professor Beach, testifying for appellant, says that there is no difference in the function when the oil is over one per cent. and when it is under one per cent. (Vol. 6, p. 3068, Q. 55) and that the process is the same in kind whether oil above one per cent. or oil under one per cent. is used (p. 3122, XQ. 228, 229).

Appellees’ witnesses had spoken of the large absorption of the fuel oil and kerosene in the clay gangue slime of the ore. The reports of appellant’s mill superintendent (Defendant’s Exhibit 227, Vol. 9, pp. 5292-5301) show that of every 26.37 lbs. of oil added on April 29, more than 10 lbs. ran to waste in the tailings.

That appellant’s 1917 procedure is metallurgically and financially inferior to its former procedure is also clear on the record.

Mr. Wilding in Vol. 8, p. 4642, Q. 136 et seq. and in Plaintiff’s Exhibit 272, Vol. 9, p. 5436 institutes a comparison between the last quarter of 1916 and the first quarter of 1917 based upon the appellant’s own figures given in its monthly statements filed in court, these periods being chosen as the nearest together

in point of time and therefore the closest approximations to each other in the matter of mill development in process and machinery. The results briefly tabulated are as follows:

	1916.	1917.
Zinc recovery	92.94%	83.11%
Zinc in concentrate	53.25%	47.23%
Zinc in tailings.....	1.24%	2.79%
Zinc lost per ton of ore.....	19.11 lbs.	43.22 lbs.
Concentration cost per ton of ore.....	\$0.82	\$1.34

Thus the 1917 procedure as compared with that of 1916 lost more of the values in the tailings, failed to achieve as high a grade of concentrate for the smelter, and cost more in the mill. It cost more to achieve less.

Mr. Wilding made a further comparison of the separate months of 1917 with selected months of 1916 when the grade of ore ran about the same, and as a final conclusion of this comparison (p. 4660, Q. 256-258, and note on Plaintiff's Exhibit 273) said that the figures show that there was a decrease of profit in 1917 from the zinc alone of about \$1.75 per ton on every ton of ore delivered to the flotation plant, and that the capacity of the mill was reduced, and that on a conservative estimate as to the market price of spelter, the decrease of profit on 580,000 tons, being about one year's capacity, would be upwards of \$1,000,000.

Mr. Wilkinson (Vol. 8, pp. 4670 et seq. and Exhibit 275, Vol. 9, p. 5443), approaching the matter from a

slightly different angle compared the appellant's figures for its flotation of zinc ore during the first quarter of 1917 as given in its sworn monthly reports, with the Timber-Butte mill figures for the same quarter for its flotation of the similar Elm Orlu ore as given in Plaintiff's Exhibit 249 (Vol. 9, p. 5355), Timber Butte Mill being that of one of appellees' licensees. The result was as follows:

	Timber-Butte Mill	Appellant's Mill
Zinc recovery	97.72%	83.11%
Zinc in concentrate	55.47%	47.23%
Zinc in tailings	0.44%	2.79%

Mr. Wilkinson gives it as his opinion that the result obtained at the Timber-Butte mill as given is considerably better, indeed notably better, than the result obtained at the appellant's mill (p. 4679, Qs 43-48).

The comment of the court below on this testimony was Vol. 1, p. cxc):

"Defendant not very insistently claims results for this latter period are more profitable than for the former. But plaintiffs' analysis, neither denied nor criticized, and beyond both, of defendant's reports and tabulations, makes manifest the fact is otherwise to the extent of about \$1.75 per ton of ore—an enormous loss on 45,000 tons monthly. There is considerable like testimony in reference to operations by other infringers."

Summing up all the testimony as to appellant's 1917 procedure, the facts stated and the opinions given of practical experts in this art and the calculations based on appellant's own reports stand uncontradicted, and furnish full basis and justification for the findings of the lower court in this regard.

It is a patent fact that it was no metallurgical necessity or advantage that prompted appellant's increase in the amount of oil since January 9, 1917. It is a patent fact that it was the Supreme Court decision upholding the patent as valid that prompted, and alone explains, that metallurgically absurd and financially ridiculous action. It is a patent fact that appellant by that action sought to just squeeze over the line that it thought marked the boundary of the appellees' monopoly—to just squeeze over the line and no more, so as to retain as much of the substance and advantage as possible, and yet appear to be outside the terms of the claims—to stay so near as to keep the substance while seeming to avoid the letter. It is a patent fact that appellant's action was "obviously intended to avoid the wording of the claims" (*Hoyt v. Horne*, 145 U. S. 302); that it was "not to bring about a product essentially different from the patented product, but to introduce a process so colorably different that it might be used as a shelter against the charge of infringement" (*National Co. v. Elkhart*, 123 Fed. 431)—*a situation that challenges the ingenuity of a court of equity to defeat it (and properly so) by considering the substance of things rather than the letter.*

The question of infringement by appellant's recent practice may be considered from the comprehensive point of view of the process as a whole, or it may be considered from the point of view of each step separately, that is to say, the action of each agitator cell and spitzkasten unit by itself. From either point of view infringement is equally manifest.

From the point of view of the general process, that part of the oil mixture which constitutes the greater part and which carries the total above twenty pounds, is inert and useless for the purposes of flotation; it is not certain that with the character of ore that appellant now treats, it even has a preferential affinity for the metal over gangue, since it seems to go indiscriminately to both; and under the conditions of its use it is prevented from assisting, and also largely prevented from defeating, the real process that is proceeding by the presence of a small fraction on one per cent. of active oil and by the presence also of a soluble frothing agent and by the terrific agitation employed. The general process is proceeding by reason of the presence of the small fraction of one per cent. of active oil, and in spite of the presence of the large fraction of one per cent. of inactive and useless oil. The oils of the mixture have been carefully selected for these respective purposes, and as the result, as Mr. Dösenbach says, of an accidental discovery made by him in 1913 that there were such inert oils that could be so used in excess quantity without defeating the main process (Vol. 6, p. 3397, XQ. 361, and he later experimented with thousands of oils, p. 3398, XQ. 370), and as the result, as Mr. Thomas Janney says, of a protracted experimental investigation carried on through two years or more (Vol. 5, p. 2543, Qs. 12-17), and perhaps the result also of the development and invention by Mr. Janney of a machine giving so violent and so often repeated an agitation, that the blighting and froth-destroying effect of the excess oil is to some extent neutralized and overcome. These young men after several years of investigation and effort, discov-

ered how to use appellees' process without, as they thought, appearing to do so. They admittedly get appellees' results. They really carry out appellees' process. *Their departure in the matter of the more violent agitation employed is not a departure toward the prior art, but away from the prior art.* And their use of an excess and useless quantity of inert oil is a mere pretense and a sham. Every element of every claim in issue is present in appellant's recent procedure, powdered ore, water, agitation, oil-coated mineral matter, the oil coating being obtained by the addition to the water of an oily liquid that has a preferential affinity for the metalliferous matter and that has besides a mineral-froth-forming power, and amounting to a fraction of one per cent. on the ore, an air-lift of the metal actually proceeding, and an air-froth actually holding the metal, that froth separated from the remainder of the pulp by air flotation, that is to say, by air-lift, and the so-separated froth being then removed. There is no real controversy as to these facts. The further addition of oily liquid that does not have a mineral-froth-forming power and that in fact does not form the mineral matter into a froth, and that does not contribute to the air-lift of the mineral or to the air-froth holding of the mineral after lifting, but that goes partly to the gangue and partly remains as unattached oil that merely floats uselessly as oil, is wholly immaterial seeing that it has no practical effect on the result either to achieve that result or to defeat it.

Considered from the more detailed point of view, that is to say, regarded as a series of processes, it is equally

clear that appellant's recent operations are an infringement.

Regarding each machine as effectuating a separate process, there are some sixty or seventy such processes in appellant's mill proceeding continuously, either side by side, or successively, as the case may be, according to the flow sheet. Everything that has been said above from the general point of view, applies to each and every machine considered separately, even to the first machine in each set. And in addition *each subsequent machine in each set after the first machine, operates upon a pulp mixture in which the proportion of oil to solid matter constantly diminishes*, and consequently, after the first machine, we have—as the mixture fed to each subsequent machine and agitated there and a mineral-carrying froth taken from it there—a mixture of oil, ore, water and acid, in which the total oil of all kinds is less than one per cent. of the dry weight of the solid matter of the ore fed to that machine at that time.

The tailings of the first cell or machine are the feed of the second and the tailings of the second are the feed of the third and so on down through the seven rougher cells of each pyramid or group. A continuous and in all essentials a complete process of concentration of ore goes in on each cell. But more oil in proportion to solids goes out in each case with the concentrate at the top than is left to go out with the tailings at the bottom. So the feed to the successive cells is impoverished in its percentage of oil to ore by successive steps. If the feed to the first cell has barely over one per cent. of oil the feed to the second cell is bound to be notably less and

under one per cent. and the impoverishment is progressive and inevitable and is notable in amount at each step and all of the operations after the first is bound to be a process conducted with less than one per cent. of oil (of every kind) to ore in its feed. By cell or machine we mean a complete Janney unit including the agitator part and the froth part or spitzkasten. There is no way in which appellant could employ a pyramid of machines, the tailings of one being the feed of the next, that would not by one or two steps so impoverish the feed in the matter of oil that the percentage of total oil to ore in such feed would drop far below one per cent.

Again in the fourth, fifth, sixth and seventh spitzkasten of the rougher machines air under pressure is introduced at the bottom, causing an additional ebullition of bubbles that sweep upward through the pulp, and "to the surface thereof, all the metalliferous matter in the form of a froth" (Patent in suit, p. 2, line 114). In all these rougher machines this additional aeration and the agitation that it achieves and the additional air-lift and air-froth that it produces, follow a mechanical agitation in a separate vessel just as described in the patent in suit, and are applied to the tailings that flow from the spitzkasten of earlier rougher cells, just exactly as it is applied in the patent in suit—a "method for the recovery of any sunk oiled metalliferous matter which may be deposited in the second and third spitzkasten" (Patent in suit, p. 2, line 103). This in itself would be an infringement if there were nothing more.

Again, as a further supplementary treatment for the recovery of any oiled metalliferous matter that may

have failed to rise in any of the series of rougher machines, and has consequently been discharged as a tailing from the bottom of the last spitzkasten, those tailings are submitted in a number of Callow cells to a final agitation effected by the introduction of air under pressure through cloth at the bottom of the cells, this again sweeping to the top in the form of a froth any oil-coated metalliferous particles that may have escaped air-lifting theretofore. The very excess and superabundance of air and of air-froth produced in this way, achieves something additional in the way of mineral recovery and so adds to the general effectiveness of the process. Considered with the preceding agitation that the pulp has received it constitutes what was held in the Miami case to be an infringement. Considered alone, it constitutes infringement, even if there were nothing more, and the bulk of the oil having gone with the concentrate, there must have been in this operation a condition paralleling that arising from the addition to the pulp of a small fraction of one per cent. of oil to solid matter, even counting all the inert and useless oil.

Infringement—The Law.

Inventions are things, not words. Infringement goes to substance, not to form. As the Supreme Court said in *Union Paper Bag Co. v. Murphy*, 97 U. S. 120:

“attention should be given to the portion of the device ‘that really does the work,’ disregarding the parts that are merely used as conveniences,”

thus going through the mask to the reality beneath the mask.

The Supreme Court in the Hyde case has in effect prejudged the question of infringement in the case at bar by laying down the test or rule by which infringement is to be judged, given ore, oil, water, agitation and mineral froth production, namely, by "the results obtained," paralleling the rule "by the test of *beneficial results*" stated in *United States Mitis Co. v. Carnegie Co.*, 89 Fed. 343. There is no controversy as to the fact that the results obtained by the appellant in the way of air-lift and air-froth and ore concentration since January 9, 1917, are the same in kind as the results obtained for the preceding five and a half years.

A defendant cannot avoid the charge of infringement by sailing so close to the limitations of the patent (even assuming that the patent were in fact to be so limited) as to get substantially all the beneficial results while avoiding only the letter. The rule stated in *Westinghouse v. Boyden* disposes of this contention *infra*, p. 156).

If "all of the *efficient* elements of the combination are retained, or their places supplied by well-known equivalents," and if the "organization is essentially the same," there is infringement (*O'Reilly v. Morse*, 15 How. 62).

A fundamental inquiry is, has the defendant got the novel result and if so how does he get it (*Columbia Works v. Rutherford*, 58 Fed. 787).

"It is the duty of courts and juries to look through the form for the substance of the invention—for that which entitled the inventor to his patent, and which the patent

was designed to secure; where that is found, there is an infringement."

Winans v. Denmead, 15 How. 330.

A line of early cases similar on the facts to the case at bar are the following:

United Nickel v. Harris, 15 Blatchford 319; 24 Fed. Cas. 727, is one of a series of cases about a patent for a process of electro-deposition of nickel in a solution free from potash and soda and also free from acid. The defendant added small quantities of sulphate or chloride of potash or soda. The plaintiff claimed that this substance was inert, being in the chemical state of a sulphate or a chloride that did not result in the presence of free potash or soda. The court said:

"If such sulphate or chloride is inert or is even of some benefit, its use is but an improvement, and the invention of the patentee is availed of, notwithstanding its introduction."

United Nickel v. Pendleton, 15 Fed. 739; 24 Fed. Cas. 732. This related to the same patent. Here the defendant put in some free acetic acid, and the court had great difficulty in deciding as to infringement because the claims said expressly that there must be no free acid; free acetic acid hindered the main process a little, but did not prevent it absolutely, and did something else that was helpful. Judge, afterward Justice, Blatchford, an able patent judge, held that that mixture, although it violated the letter of the claim, was an equivalent of the mixture of the claim, and an infringement.

These were the claims of the Adams patent:

“1. The electro deposition of nickel by means of a solution of the double sulphate of nickel and ammonia, or a solution of the double chloride of nickel and ammonium, prepared and used in such a manner as to be free from the presence of potash, soda, alumina, lime or nitric acid, or from any acid or alkaline reaction. 4. For, the electro plating of metals with a coating of compact, coherent, tenacious, flexible nickel of sufficient thickness to protect the metal upon which the deposit is made from the action of corrosive agents with which the article may be brought in contact.”

Judge Blatchford cited previous decisions on this same patent as follows:

“In the Keith case in February, 1874, the validity of the patent was again sustained, and infringement of claim 1 was adjudged, because of a use, in the electro-deposition of nickel, of a solution of the double sulphate of nickel and ammonia, although such solution contained a small proportion of tartrate of ammonia, and a small proportion of ammonia, the first of these being an inert substance in the solution and the second being speedily eliminated by evaporation when the solution was used.

“In the Harris case in October, 1878, the patent was held valid. Claim 1 was held to be a claim to the electro-deposition of nickel by means of any solution of the double sulphate of nickel and ammonia, or of any solution of the double chloride of nickel and ammonium, however such solution may be prepared, provided such solution is so used as to be free, while the electro-deposition of nickel is going on, from the presence of potash, soda, alumina, lime, or nitric acid, or from any acid or alkaline reaction. Infringement of that claim was adjudged, and it was held that although a sulphate or a chloride of potash or soda might be introduced into either of the named solutions, yet, if the solution was so used, in the electro-deposition of nickel, that the sulphate or the chloride would not be decomposed, the claim was infringed * * * (p. 741).

“In the Manhattan Brass Case in March, 1879, infringement of claim 1 was adjudged, and it was held that that claim was infringed, although the salts of potash and soda were introduced into the solution, provided the solution was not so used as to liberate free potash or free soda.”

Now, in this last case (the Pendleton case), which came before Judge Blatchford, the facts were that the defendant had added an acetate of nickel solution, and an excess of acetic acid. Said Judge Blatchford (p. 743):

“The evidence shows that a pure acetate of nickel, used without an excess of acetic acid, will, under proper conditions of strength of current and strength of solution, produce such a reguline deposit of nickel as Adams’ patent contemplates, and that the absence of any acid or alkaline reaction in the acetate produces the best results, especially as to the quantity of metal deposited with a given battery power in a given time. An excess of acetic acid impairs the efficiency of the solution. It is shown that the presence of an acid reaction, by turning litmus paper red, by no means indicates the presence of free acid, so as to make a practically injurious departure from neutrality, in the direction of acid reaction. On the other hand, it appears that an excess of acetic acid has the effect to neutralize the deleterious properties of such alkaline substances as soda, potash and lime, which, if finding their way into the solution, will injure the quality of the deposit. * * *

“At the time of Adams’ invention it was known that the addition of a slight excess of acid to a simple salt of nickel would prevent the deposit of oxide of nickel upon the cathode, by taking up the oxide, and thus act in the same manner as ammonia salts, in the solutions of the Adams’ patent. Under the foregoing premises, as a simple acetate will produce a greater deposit of nickel for the same amount of current in a given time than will a simple acetate with a slight excess of acetic acid, and as such slight excess of acetic acid will prevent the injurious

deposit of oxide of nickel in case certain alkaline impurities are present, and as that result is accomplished in the same way as by the use of ammonia salts in the solution of Adams' patent, those solutions and the defendant's solution are equivalent, in nickel-plating, and in their mode of operation and in the character of the deposit.

"The fair reading of the Adams specification is that, in order to obtain the best results, the solution should be as nearly neutral as possible, and should be especially free from acid. The invention of Adams, as shown in his specification, so far as respects sulphuric and hydrochloric acid, was that the presence of such quantities of those acids as would be likely to get into the solutions named in claim 1, in preparing and using them, would prevent any useful result. Infringement of the claim cannot be avoided by introducing such small quantities of any of the injurious substances named by Adams as will produce no practical injurious effect. * * *

"Before Adams, no product possessing the properties described by him as those of his product was known. He introduced a new process, that of claim 1, as well as a new product or manufacture, that of claim 4. In attempts at nickel-plating before, acids had been used which were known solvents of nickel. Adams used those acids to prepare his solution. * * *

"Adams did not invent the solutions of claim 1. He showed how to prepare and use them successfully. The solution is the vehicle whereby the nickel is conveyed from the anode to the cathode, holding in suspension the nickel to be deposited, and supplying the place of the deposited nickel by taking other nickel from the anode. The real invention was in discovering the proper condition for the use of such vehicle, not the particular chemical composition of the vehicle. Any proper vehicle used with those conditions would do the work. * * *

"If claim 1 of the Adams patent claimed the discovery of a new solution, as does claim 1 of the defendant's patent, the question would be a different one. But the claim is a claim to a new method of using solutions, requiring specified conditions by the absence of specified injurious elements. The defendant uses his solution in

the same way, avoiding those injurious elements, and observing the prescribed conditions. * * *

“The case of *Tilghman v. Proctor*, 102 U. S. 707, is an authority for the conclusion that, on the foregoing facts, claim 1 of the Adams patent ought to have the construction above indicated, and that so construed, it is infringed by the defendant. It is a claim for a process which Adams invented. He describes a mode, and the best mode then known, of carrying it out with success. All that the defendant has done is not to vary the process, or its mode of working, or its essential conditions, but to apply a new solution worked in the same way and under the same conditions. It must, therefore, be held that infringement of claim 1 is established.”

In *United Nickel Co. v. Central Pac. R. Co.*, 36 Fed. 186 (Ross, C. C., 9th Circ. 1888), the court in charging the jury, said that the Adams patent had been held valid by the courts many times, so that the “real inquiries will therefore be limited first to the question of infringement” and afterwards damages.

Page 188:

“If, therefore, you find from the evidence that defendant used the process described in the first claim, or manufactured the product described in the fourth claim, of the patent, you will find the question of infringement against the defendant.

“Nor can the plaintiff’s patent be defeated by evasion—that is to say, by any mere colorable or unsubstantial change in the process or mode of bringing about the same result. Upon this point the language of Mr. Justice Blatchford in a case involving the infringement of the same claims of the same patent now before you, is very instructive. In that case the defendant claimed to have used, in the process of nickel-plating, a solution essentially different from that covered by the Adams patent.”

After quoting much that we have quoted above, the court adds:

“In the light of these instructions, it is for you gentlemen of the jury, to say from all of the evidence in the case, whether the defendant used one of the solutions referred to in the third claim of the patent, or some other solution, the chemical equivalent of it, in the process described in the first claim, or in the manufacture of the product described in the fourth claim of the patent; in other words, whether the alleged infringement has been established against the defendant.”

An instructive case is *Perkins Electric Switch Mfg. Co. v. United Electric Const. Co.*, 191 Fed. 366 (C. C. A., 3rd Circ., Gray, Buffington and Lanning, C. Js., opinion by Buffington, C. J.).

Perkins' patent for an incandescent lamp socket held infringed—reversing the Circuit Court.

The court said (p. 368):

“It follows, therefore, that closure or non-closure of the abutting chambers in respondent's device at the place where it is left open is a negligible, functionless matter. * * * Having, by virtue of this recessed location of the switch and the solid wall across the current path made the two chambers electrically insulate, does the respondent became a non-infringer by breaking down the wall at a point beyond, where whether it be perforate or imperforate in no way affects the working of the device?

“Assuredly not, unless mere form and functional substance are the same thing. With as much justice could it be said that a ship that was staunch and tight below the water line was leaky because of its scupper holes.”

Columbia Wire Co. v. Kokomo Steel & Wire Co., 143 Fed. 116 (C. C. A., 7th Circ., 1905, Grosseup, Baker and Seaman. C. Js. Opinion by Seaman, C. J.)

Patent held valid and infringed.

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“We are of opinion that the means thus transposed in the appellee’s machine, if not within the definition of colorable evasions which infringe the patent in any view of its scope, are plain appropriations of the essence of the Bates conception by equivalent means, and infringements of the patent within the well settled rule referred to. All the elements of the patent combination are employed with substantial identity in their use, and departure appears from the letter of the claims only, in the arrangement of these elements, without substantial difference in the principle of operation. The policy and rules of the patent law require that the patentee be protected against such evasions of the wording of a claim in form or nonessential details, when the substance of the invention is thus used and is unmistakably shown in the specifications and claims.” (Winans v. Denmead, 15 How., 330, 343; 14 L. Ed. 717; 5 Notes U. S. Rep. 331; Ives v. Hamilton, 92 U. S. 426, 431; 23 L. Ed. 494; Machine Co. v. Murphy, 97 U. S. 120, 125; 24 L. Ed. 935, and 9 Notes U. S. Rep. 533; Elizabeth v. Paving Co., 97 U. S. 126, 137; 24 L. Ed. 1000; Hoyt v. Horne, 145 U. S. 302, 308; 12 Sup. Ct. 922; 36 L. Ed. 713; Westinghouse v. Boyden Power Brake Co., 170 U. S. 537, 568; 18 Sup. Ct. 707; 42 L. Ed. 1136; International Mfg. Co. v. H. F. Brammer Mfg. Co. [C. C. A.], 138 Fed. 396, 400.)

* * * * *

Page 123:

“The remaining contention, that the appellee’s device escapes infringement through its additional means and function in the automatic regulation of tension, does not impress us as tenable. * * * This is a mere addition to the patented machine, supplementing the function of one element, without changing the co-operative function of the wheels in their combination. So, assuming that it is an important improvement (which is disputed in the appellant’s testimony) and patentable as an improvement, its association with the means of the prior patent is

unauthorized without license from such patentee." (Cochrane v. Deener, 94 U. S. 780, 787; 24 L. Ed. 139; Cantrell v. Wallick, 117 U. S. 689, 694; 6 Sup. Ct. 970; 29 L. Ed., 1017; Hoyt v. Horne, 145 U. S. 302, 309; 12 Sup. Ct. 922; 36 L. Ed. 713; Walker on Patents [3d Ed.] § 347).

"The alleged improver may have a valid patent for his new means and is entitled to its exclusive use; but the prior patent equally excludes him from the use of the prior invention, with or without his improvement."

In the case of *Ford v. Tannage Company*, 84 Fed. 644 (C. C. A., 3rd Circ., 1898, Acheson, C. J., and Butler and Kirkpatrick, D. Js., opinion by Kirkpatrick, D. J.), the patent was for a process of tawing hides by a bath of chrome salts followed by a bath evolving sulphurous acid, and the result was leather. The defendant used a bath of alum salt and chrome salt, followed by a bath evolving sulphurous acid, and the result was leather. Now a bath of alum salt, followed by the bath evolving sulphurous acid, would not produce leather. The court found, as a fact, that the addition of the alum salt by the defendant did not prevent the action of the chrome salt and that the result was chrome-tawed leather just the same, and held that the mere addition did not avoid infringement. The court said:

"It is clearly shown that the addition of the sulphate of alumina to the bath does not prevent the thorough absorption by the hide or skin of the bichromate of potash."

So here, the addition of the inert petroleum products and the fact that some of the pine oil is dissolved in the water, and that much of the petroleum oil is ab-

sorbed in the clay of the gangue slime, and that some of it flows off uselessly as oil, does not prevent the main process from proceeding by the co-action of a fraction of one per cent. of active froth-forming and froth-modifying oil with the agitation to produce modified air bubbles that separate and lift the mineral particles and hold them mechanically suspended in the bubble films of an air-froth.

Atlantic Giant v. Dittmar, 9 Fed. 316, is another example of *addition* not avoiding infringement, and *Washer Company v. Cramer*, 169 Fed., page 629, the latter by Judge Gray of the Circuit Court of Appeals of the Third Circuit. In the latter case a spring driving-handle moved a washtub back and forth, the flexibility of the handle cushioning the blow. The defendant put a fixed cushioning spring at each end of the travel of the handle, and used a handle that was only a little bit flexible, but the court said:

“These cushioning springs were a mere addition to the complete structure of the complainant’s device. They supplemented the cushioning function of the driving spring, but did not dispense with it. The defendants do not substitute anything for the patented device, but employ it in its entirety, and then merely add elements, which, without destroying its functions, supplement or partake of them.”

In the *National Newsboard Company v. Elkhart*, 123 Fed. 431 (C. C. A., 7th Circ., Jenkins and Grosscup, C. Js., and Bunn, D. J., Opinion by Grosscup, C. J.), the patent was for grinding up old newspapers for paste-board, the old ink being retained and that being the novelty. It had been the practice to bleach the old

ink off by a bleaching agent and then use the product for pasteboard, using ten or twenty per cent. of an alkali in hot water for the bleaching operation. The defendant there used one per cent. of alkali in cold water and of course contended that it was using the process of the prior art. But the court held that the defendant had infringed.

“But there was no attempt at bleaching after the boiling and the alkali was insufficient to remove but little of the oils. Plainly the removal of the oils was not intended. The whole testimony impresses us with the belief that the introduction of the soda ash was intended, not to bring about a product essentially different from the patented product, but to interpose a process so colorably different that it might be used as a shelter against the charge of infringement.”

And so it is here, because there is no possible reason or excuse in metallurgy or in common sense for this defendant to add in the mixing tank 12 to 18 lbs. of a wholly unnecessary, inert and non-frothing oil when it can do better work and make more money and have a more efficient concentration by using only the active frothing oil (which its mixture of course includes) in an amount much less than one per cent. on the ore.

Cowles v. Lowrey, 79 Fed. 331, is an example of a primary invention; a patent broadly construed; and an addition not avoiding infringement.

So *Goodwin v. Eastman*, 213 Fed. 231, a chemical case somewhat like this one; a pioneer patent; a broad construction.

Another line of authorities is what is called "the rule" of *Westinghouse v. Boyden*, 170 U. S. 537, 568. The rule stated there, and said there to have been repeatedly held by the court (although it did not find application to the facts of that case) is that:

"a charge of infringement is sometimes made out, though the letter of the claims be avoided."

That is to say, even though the letter of our claim were limited to the addition in the mixing tank of a total of less than one per cent. of oil, active or inactive, frothing or non-frothing, beneficially used or mostly wasted, the charge of infringement might be made out even though a total of more than one per cent. of oil were added in the mixing tank. It would still remain to be determined whether an equivalent thing had not been done, whether the substance of the invention had not been taken.

Thus in *Topliff v. Topliff*, 145 U. S. 156, Mr. Justice Brown says:

"The object of the patent law is to secure to inventors a monopoly of what they have actually invented or discovered, and it ought not to be defeated by a too strict and technical adherence to the letter of the statute, or by the application of artificial rules of interpretation."

In *Turrill v. R. R. Co.*, 1 Wall. 491, it is said:

"Patents for inventions are not to be treated as mere monopolies, and, therefore, odious in the eyes of the law; but they are to receive a liberal construction, and under the fair application of the rule, *ut res magis valeat quam pereat*, are, if practicable, to be so interpreted as to uphold and not to destroy the right of the inventor."

In *Hoyt v. Horne*, 145 U. S. 302, the patent was for a rag machine in which the pulp circulated, so said the claim, in vertical planes and also was delivered into an upper section of the vat. Now the defendant did not circulate it in vertical planes but in horizontal planes. He did not deliver it into the upper part of the vat but into the lower part. But the court held that what he did constituted the substance of the operation and infringed; and, says the court, the device was "obviously intended to evade the wording of the claims."

Underfeed Stoker v. Sanford, 215 Fed. 392, is a good example of a departure from the letter of a claim being held not a departure from the substance. The claim included an air chamber "beneath the retort." The defendant bricked up that air chamber and wholly eliminated its useless function but achieved its useful function by making an outside air chamber contacting with parts of the sides of the retort that needed cooling but not "beneath the retort" and so kept the essential function, and he was held to infringe.

The rule of liberality in the construction of patents, for pioneer inventions and for inventions which, whether pioneer or not, have revolutionized or greatly advanced an art, is well illustrated in decisions of this court.

Thus in *Von Schmidt v. Bowers*, 80 Fed. 121, it was said by this court (p. 148):

"The record shows that the complainant was the first to combine those elements at all, and that the functions

performed by his machine so constructed were entirely new. Hence he had the right to make the broad and generic claim embodied in claim 10, without any limitation as to the form of construction of the particular elements, and all subsequent machines which employ substantially the same means to accomplish the same result are infringements, notwithstanding the subsequent machine may contain improvements in separate mechanism which go to make up the machine."

and p. 151:

"Giving the complainant's patents the broad and liberal construction to which we think them justly entitled, it is clear that the second machine of the defendant constitutes an infringement, etc."

In *Letson v. Alaska Packers' Ass'n.*, 130 Fed. 129, this court said (p. 139):

"Before discussing the question of infringement, it is important to determine the nature of the Jensen invention, and to ascertain how far the claims thereof are affected by the prior state of the art."

After considering the prior state of the art the court continues (p. 140):

"So that while it cannot be said that the Jensen machine was a pioneer patent, in the sense that it was the very first to accomplish the result of heading filled cans, Jensen nevertheless was the first to successfully head filled cans with any practicable degree of speed or efficacy. He brought to success what prior inventors had essayed, and but very imperfectly accomplished. In so doing he adopted some devices that had been used before, combined them with others that had not been used and added the necessary elements to make a practical and successful machine. His combination and invention was, we think, more than a mere improvement or perfection of what had preceded it. It was of such novelty and importance as to constitute a distinct step in the progress of the art, and it went into immediate and extensive use. Its claims are therefore entitled to a fairly liberal con-

struction. *Morley Machine Co. v. Lancaster*, 129 U. S. 263, 273; 9 Sup. Ct. 299; 32 L. Ed. 715.”

Some claims were held infringed, the court saying (p. 143):

“Infringement is not avoided by the fact that at the same time a revolutionary movement is imparted to the mechanism, which carries both the cap and the can during the operation. *Ives v. Hamilton*, 92 U. S. 426; 23 L. Ed. 494; *Machine Co. v. Murphy*, 97 U. S. 120; 24 L. Ed. 935; *Brush v. Condit*, 132 U. S. 39; 10 Sup. Ct. 1; 33 L. Ed. 251; *Hoyt v. Horne*, 145 U. S. 302; 12 Sup. Ct. 922; 36 L. Ed. 713.”

And

“It is unimportant that the appellants do not accomplish by their plunger all that is accomplished by the appellee’s. The two devices are the same, and the appellants cannot avoid infringement by failing to make use of the upper plunger for all purposes for which it might be used.”

In *American Can Co. v. Hickmott Asparagus Canning Co.*, 142 Fed. 141, this court said (p. 144):

“The question which is presented to us on the appeal is one of infringement only, and in determining that question it becomes necessary to consider the nature of the Jordan invention, and to determine how far it is protected against the use of mechanical equivalents. Prior to the Jordan patent, can-bodies were formed upon non-rotating fixed horns, which were hollowed out in their interior and provided with mechanism to cause them to expand. Hooks were first formed on the ends of the sheets of tin for the interlocking seams. The sheets were then placed transversely across the upper surface of the fixed horn, and were shaped around it by folding arms curved to fit the horn and to cause the hooks to come into engagement. Then by the expansion of the horn the hooks were interlocked. The term ‘mechanical equivalents’ has a variable meaning, and is measured by the

character of the invention to which it is applied. The appellant contends that the Jordan invention was pioneer. But we think it cannot be said that Jordan was a pioneer inventor in the sense that he was the first to produce a machine to successfully form can-bodies. He was the first, however, to form can-bodies by the use of a rotating horn. In so doing, he made a highly meritorious improvement, and an invention which marks a distinct step in advance in the progress of the art, and which has gone into extensive and successful use. His invention must be accorded a place inferior, perhaps, to that of a primary invention, but far in advance of those which constitute but a slight improvement on the prior art. His claims, therefore, while not entitled to the broadest construction accorded to the former, are not to be restricted to the narrow construction applicable to the latter. He is entitled to the protection of the doctrine of equivalency in proportion to the nature of the advance which his invention indicates. In *Penfield v. Chambers Bros. Co.*, 92 Fed. 630, 638; 34 C. C. A. 579, Judge Severens said:

“ ‘The rule applicable to the determination of equivalency depends upon the importance and the breadth of the original invention, and does not depend upon the question whether it was the first in the field relating to that subject, but upon the degree of advancement which the invention has made in newness of discovery and utility; for there may be as much merit in bringing on a large illumination from a feeble start as in the conception of the first beclouded idea which may have originated in the course of study and discovery along that line.’

“ ‘See, also *McCormick Harvesting Machine Co. v. Aultman, Miller & Co.*, 69 Fed. 371; 16 C. C. A. 259; *Muller v. Tool Co.*, 77 Fed. 621; 23 C. C. A. 357; *Letson v. Alaska Packers Ass’n*, 130 Fed. 140; 64 C. C. A. 463; *Miller v. Eagle Mfg. Co.*, 151 U. S. 186, 207; 14 Sup. Ct. 310; 38 L. Ed. 121.

“ ‘It is plain to be seen that the Jordan invention is not founded on the earlier art. There was nothing in the preceding inventions to suggest the idea of a rotatable horn and of attaching the edge of a sheet of tin thereto and rolling it up in the form of a can-body. His patent

is entitled, therefore, to stand for what the claims import, free from limitations imposed by the prior art."

In *Los Angeles Art Organ Co. v. Aeolian Co.*, 143 Fed. 880, this court said as to a patent for a mechanical musical instrument (p. 883):

"It will thus be seen that the essence of their discovery, which is the gist of their invention, was by causing special control perforations in each sheet to exercise control over the other sheet, and over its driving mechanism, thus making the sheets themselves the instrumentality for retarding either sheet running ahead until the other sheet should catch up and re-establish exact synchronism. Such was also the gist of the patent obtained by Fleming.

"This discovery was important. Tremaine & Pain were not mere improvers upon a prior machine which was capable of accomplishing the same general result. They brought to success what prior inventors had been unable to accomplish. It was difficult, and had been considered impossible. They adopted some devices that had been used before, combined them with others that had not been used, and added the necessary elements to make a practical operative machine. Their invention was therefore more than a mere improvement or perfection of what had preceded it. It was of such novelty and importance as to constitute a distinct step in the progress of the art and the claims of their patent are therefore entitled to a broad and liberal construction. * * * Appellant did not introduce any evidence, nor set up any patent, printed description, actual construction, or any other matter, prior to the invention of Tremaine & Pain, by which two music sheets were mutually controlled, nor was any evidence offered by appellant to anticipate or restrict any portion of the invention made by Tremaine & Pain. Under these circumstances it seems manifest that they were pioneers."

and p. 887:

"We are of opinion that the Fleming patent clearly embodies the invention of Tremaine & Pain, and is an

infringement of that patent. It is true that Fleming made several minor changes in the arrangement of his mechanism, and constructed some parts in a different manner, but throughout the whole the essential principles of the Tremaine & Pain patent exist. When the discovery was made and explained to the public by Tremaine & Pain, it could readily be seen by other inventive and mechanical minds that the means by which the result was produced were simple and plain, and that the result could be accomplished by slight changes in the construction of the mechanical musical device. It is apparent that Fleming, with his intimate knowledge of the construction made under the Tremaine & Pain patent, was able to make changes in some of the means used, and in making these changes he may have improved in some particulars upon the means used in the prior invention.

“The rule is well settled that if two machines be substantially the same, and operate in the same manner, though they may differ in form, proportion and utility, they are the same in principle. As was said in *Converse v. Cannon*, 2 Woods, 7 Fed. Cas., No. 3144:

“‘In passing upon the issue of infringement, the question to be determined is whether, under a variation of form or by the use of a thing which bears a different name, the defendant accomplished by his machine the same purpose or effect as that accomplished by the patentee, or whether there is a real change of structure or purpose. If the change introduced by the defendant constitutes a mechanical equivalent in reference to the means used by the patentee, and if besides being an equivalent, it accomplishes something useful beyond the effect or purpose accomplished by the patentee, it will still be an infringement as respects what is covered by the patent, although the further advantage may be a patentable subject as an improvement on the former invention.’ * * *

“In *Blandy v. Griffith*, 3 Fish. Pat. Cas., 609 Fed. Cas., No. 1529, the court said:

“‘As long as the root of the original conception remains in its completeness, the outgrowth—whatever shape it may take—belongs to him with whom the conception originated.’”

In *Holt Mfg. Co. v. Best Mfg. Co.*, 172 Fed. 409, this court said in defining a pioneer patent (p. 414):

“We think it very plain, from what has been said, that Best cannot be properly regarded as a *pioneer inventor, who is one who stands at the head of the art, or who has at least made such a distinct step in its progress as to distinguish it from a mere improvement or perfection of what had gone before*, and that the court below should have so instructed the jury and not have left it to them to determine that question.”

In *Parker v. Stebler*, 177 Fed. 210, this court said of a patent for a hand truck which was held valid and infringed (p. 214):

“We think, in view of the prior art, that the Bryan invention marked a distinct step in advance, whereby a notable success was achieved, and that its claims are entitled to a fairly liberal construction.”

In *Stebler v. Riverside H. Orange Growers' Ass'n.*, 205 Fed. 735, this court said (p. 739):

“The defendants have appropriated the plaintiff's invention, the essence of which is the combination with a traveling belt (common to the Ish, Strain, and Parker machines) of a series of independent rotating units arranged in longitudinal succession parallel with the belt, each transversely adjustable. One who appropriates another's patented invention, even though he may add thereto another element to perform an additional function, is guilty of infringement. * * *

“True, the plaintiff's rights do not extend beyond the claims in suit, and are subject to the limitations thereof; but the language of these claims is not, as argued by the defendants, to receive a narrow, literal construction. While the invention is not basic or primary, it is substantial and important, and is therefore entitled to a fair range of equivalents. *Continental Paper Bag Co. v. Eastern Paper Bag Co.*, 210 U. S. 405; 28 Sup. Ct. 748; 52 L. Ed. 1122.”

In *Detroit Copper Mining Co. v. Mine & Smelter S. Co.*, 215 Fed. 100, this court said of the patent for the Wilfley tables for water concentration (p. 103):

“The improvement made by Wilfley, as measured by the prior art and as proven by the testimony, is evidently of such merit that the claims of his patent are entitled to a reasonably liberal construction. The mere form of his table does not measure the scope of his invention. He did more than to invent a table of a precise form and configuration. He discovered a method of application of principles and an effectual mode of operation, and the appellee should be protected in that feature of the combination which is new in principle and function.”

After discussing the Deister table, used by the appellants, the court said:

“We are of the opinion that the use of these deflected terminals so greatly reduced in elevation does not serve to differentiate the Deister table from that of the patent in suit, whether the space covered by them be regarded as substantially a smooth surface, as was held in *Wilfley v. Denver Engineering Works Co. et al.* (C. C.). 111 Fed. 760, and in *Mine & Smelter Supply Co. v. Braeckel Concentrator Co.* (D. C.), 107 Fed. 897, or whether they be regarded as a continuation of the riffles. There is presented in either view a table with riffles terminating in a diagonal course with reference to their general direction, a course which is essential to the successful operation of either table, and thereby the appellants have availed themselves of the distinctive feature of the Wilfley table, and therewith they have performed the same function by the same means, and in substantially the same manner, as in the Wilfley combination.”

CIRCULATING MIDDLEINGS.

Three or four of the appellant's witnesses, connected with the appellant and the allied companies of the

Jackling group, in presenting their facts and figures as to oil wasting operations have for the first time in their practice and experience and evidently as a new idea, and in most instances after failure to run their mills with 20 pounds or more of oil to the ton of ore, had the returned middlings analyzed for oil and have added that oil in their calculations and on their exhibits to the feed of new oil on the theory that it is just so much oil introduced to the head of the machine; and in this way apparently they hope to persuade the court that when they employ only 14 or 15 pounds of oil they are really employing 20 pounds or more. But the testimony of all the practical men produced for the appellees has shattered this theory and quite apart from that a brief consideration will show its fallacy.

These middlings are low grade concentrates which have been through the process but which require improvement in grade by retreatment in the process before they are ready for delivery as finished concentrates. The analyses of the oil in these middlings show the total quantity irrespective of condition. The oil in the middlings may be in the condition of a coating upon the metallic particles. All the metallic particles in the middlings should be thus coated. The oil in the middlings at appellant's mill may be largely or wholly absorbed already in the clay gangue slimes that are largely present in the middlings and useless for the purposes of the process. It may exist in the returned middlings as minute particles of semi-solid grease, each particle effectively enveloped with water and useless for

the process. It may exist in the form of a water-oil emulsion that would be useless for the purposes of the process. The theory takes no account of these things.

Again, the theory takes no account of the fact that if the returned middlings contain any oil in a condition fit and suitable for effective use in the process, that oil has emerged in that condition from one or other of the spitzkasten at the foot of the machine, which means that it has passed through the machine, that is to say, has passed through the process, without being utilized. Under stable conditions the pouring of usable because unused oil into the head of the machine with the middlings, means the pouring of usable because unused oil out of the foot of the machine to exactly the same amount. The theory overlooks this fact entirely. It adds the usable oil that flows into the sludge tank at the head of the machine, but forgets to subtract the equal amount of usable because unused oil delivered continuously from the foot of the machine. When this fact, however, is understood, it will be seen and realized that the assumption that a steady stream of oil suitable for the purposes of the process flows into the head of the machine all day long with the returned middlings, and is used in the process, includes equally the assumption that that precise amount of oil is flowing out at the foot of that machine in that same condition, and therefore is flowing constantly through the machine in that same condition, that is to say, unutilized. That amount of oil, therefore, might just as well flow down the outside

of the machine in a launder and then back with the middlings, and so on continuously.

The process in suit starts with an unoled ore and water and as the process proceeds the metalliferous mineral particles become coated with oil. Any concentration effected by the process whether the concentrate froth is rich enough in metalliferous mineral to form a finished product or is to be deemed a middling and returned for further treatment, involves substantial increase in oil proportion in this concentrate froth as compared with the original mixture of unoled ore, water and oil. For example, in the experiments performed by Prof. Chandler in the Hyde suit the original proportion of oil to the dry material or ore treated was .16%, 3.2 lbs. per ton (.64 grams to 400 grams), the average proportion of oil to dry material in the middlings was .33%, 6.6 lbs. per ton, and the average proportion of oil to dry material in the concentrates was .42%, 8.4 lbs. per ton (Vol. 2, pp. 160, 161). The oil proportion was more than doubled in the middlings and nearly trebled in the concentrates, but the metalliferous mineral proportion was increased in like ratios. The metalliferous mineral was oil-coated and whenever its proportion was increased the oil proportion was increased. The process was undoubtedly one employing 3.2 pounds of oil to the ton of ore, not either 6.6 lbs. or 8.4 lbs. per ton as in the two products of the process. In the middlings and concentrates *the oil was used* oil attached to the metalliferous mineral, and it would be ridiculous to say that, when you

carry this middling back to the point of beginning of the process where new ore and new oil were added, mix it with the new material and put it through the process again, you had thereby increased either the consumption of oil or the use of oil in the process. Yet this is the theory of appellant.

But the testimony absolutely disposes of this absurd contention.

Thus Greninger (Vol. 8, pp. 4342, 4343, Qs97-101) says that this oil theoretically returned in the middlings is never counted as oil supply, that it does not help extraction, that it does not save oil, and that the return of the middlings is only to raise the grade of the middlings.

So Mr. Chapman to the same effect (p. 4437, Q. 45).

So Mr. Wiggin of the Anaconda Company (pp. 4926-4928, Qs19-23) who testified:

“Q20. Do you ever take into account the oil contained in the returned middlings in determining the consumption of oil in the process?

A. We do not. * * *

Q22. Does that return of middlings result in economy of oil in the total process so far as you have observed?

A. No.

Q23. In the matter of consumption of oil in the total process so far as you have observed, does it make any difference whether middlings are returned to the head of the same machine or are returned [sent] to a cleaner machine?

A. I have observed that it makes no difference.”

So also Mr. Rossberg, of the Timber Butte Mill, at p. 2361, Qs103-107.

It repeatedly appears in the testimony that, notwithstanding the presence of large amounts of oil in the middlings, this oil will not carry on the process and when the new feed of oil is discontinued, the work of the process stops (Punchon, Vol. 7, pp. 3849-3851; Sutherland, pp. 3852-3855).

It appears from the testimony of all the young men produced as witnesses by the appellant from the Jackling group of infringers (Dosenbach, the Janneys, Conrads, Wicks and Engelmann) and from the exhibit tables which they produce as to the practical operations of their respective companies, that none of them ever prior to late December, 1916, counted in as a part of the oil supply (or even measured or assayed) the oil delivered into the sludge tank as a part of the returned middlings. The idea of doing so seems never to have occurred to any of them until after the decision of the Supreme Court in the Hyde case, and in most instances after failure in their efforts to operate their mills at 20 pounds of oil to the ton of ore. Obviously the point is of no importance and only serves to accentuate the difficulties that all of these infringers have met with in their attempts to disguise their processes and to obtain the new results first obtained by the process in suit under conditions such as they hoped would enable them to evade the patent.

PRIOR PRACTICAL ART.

When the process of the patent in suit came into being the concentration of ores was being carried on by the wet or gravity or *water concentration process*, with employment of jigs, shaking tables, vanners, and the

like apparatus for washing the gangue away from the metal.

The efforts to utilize oil had produced only two processes which reached the mill. And these two processes failed in the mill.

One of these was the *Elmore oil-buoyancy flotation process*. As Mr. Ballantyne testified in 1912, in the Hyde suit:—

“This process was to some extent successful in practice, but the technical literature showed that the Elmore process had been abandoned by 1905, and as I have stated, the process has not been heard of in practice for many years” (Vol. 2, p. 362).

Here the values went to the top.

The other of these oil processes was the *Cattermole metal-sinking process*. This received the most careful study in the laboratory from 1902 (Ballantyne, pp. 362, 363) up to the birth of the invention of the patent in suit in early March, 1905. It was in course of installation in Australia in a plant having a capacity of 100 long tons per day when the invention here in issue was made, and it was put to work in April, 1905 (Chapman, pp. 243-245, Qs15-21). It was operated for only a few days and then abandoned (Q22) and the apparatus was then operated with a makeshift hybrid process wherein the recovery was made by skin flotation on shaking tables, and the plant proceeded to run on these lines until the invention in suit saved the situation and relegated the Cattermole process, its modifications and its supplements, to desuetude.

In this Cattermole process the values went to the bottom.

PRIOR DOCUMENTS.

The above is the simple history of the practical prior art. But it is the privilege of a defendant to dig up from obscurity any and all public documents whatsoever, how little instructive they may have been to the practical art, and to endeavor to point out in these documents an anticipation of the invention. A considerable array of such documents is in evidence. Every one of them referred to at the trial herein except the California Journal of Technology, was in evidence in the Hyde case and was disposed of by the decree of the Supreme Court of the United States in that case. Other documents have been referred to which were not public documents, such as the Kirby patent applications (which became patents and therefore public documents subsequent to the birth of the invention in issue) and the Froment description. All of these private documents referred to at the trial herein were exhaustively discussed in the Hyde case and are disposed of by the decree of the Supreme Court in that case.

Appellant's brief does not mention the California Journal of Technology, the only new alleged anticipation. Apparently therefore it is abandoned. But while abandoning any defense of anticipation, appellant's brief is written throughout upon the false assumption that there existed in the prior art processes exactly the same as the process in suit except that they employed more oil. This is absolutely false, and its falsity can best be shown by a consideration of the actual dis-

closures of those documents of the prior art referred to in the new evidence in the case at bar.

HAYNES BRITISH PATENT.

This patent No. 488 of 1860 (printed Vol. 3, pp. 1265-1269) was offered in evidence in the Hyde suit and contains the first suggestion of the use of oil in ore concentration.

In the Hyde suit no witness for defendant referred to this patent. The evidence in behalf of plaintiffs describing it was uncontradicted and may be summarized as follows:

“The Haynes British patent No. 488 of 1860 contains the first disclosure of the use of oil for ore concentration. The ore is mixed with oil to form a stiff paste, which is then kneaded with water to wash out the gangue. It is not a practical process” (Liebmann, Vol. 3, p. 751).

Dr. Chandler also described this process as one in which a stiff paste was formed with, in one instance 20% and in another instance 11% of oil to ore, and this paste was triturated in water to wash out the gangue (pp. 870, 871). Mr. Ballantyne also similarly described this process and said it was entirely impracticable, and never could have been of any use (Vol. 2, p. 379). This was all of the evidence in the Hyde case in regard to this patent. Nevertheless counsel for Hyde asserted in argument in this court that the Haynes patent disclosed a froth flotation process, substantially the same as and of equal efficiency and usefulness with the process in suit.

Contrasted with this wholly false representation as to the Haynes disclosure we find the Haynes process measured at its true value in the Privy Council judgment (*Ore Concentration Company Ltd. v. Sulphide Corporation Ltd.*, 31 R. P. C. 206), a copy of which appears in the Transcript of Record in the Supreme Court of the United States in the Hyde suit (annexed to the petition for rehearing in this court). We quote from that copy, page 749:

“Haynes patent, published in 1860, describes a method of separation of metal from gangue by the use of an agent containing fatty or oleaginous matter. This document is, however, not more than an indication of the date at which attention was first directed to the affinity of oil for metals”, etc.

In the trial of the present suit appellant's patent expert Dr. Sadtler classifies the Haynes invention as one in which all of the ore particles were agglomerated by oil into masses, from which the gangue was separated by a washing out process (Vol. 5, p. 2780), and says that he does not cite it “as prior art, strictly speaking” (p. 2842). This is accurate and disposes of the false representation made to this court in the Hyde suit that it discloses a mineral-froth-producing process.

EVERSON PATENT.

This patent No. 348,157 dated August 24, 1886 (printed Vol. 4, pp. 2057-2059), was one of the five patents finally relied upon in the Supreme Court by the respondent (defendant) in the Hyde suit as an anticipation of the patent in suit (see Opinion, pp. 1, 2). It

was also referred to as one of the two patents which the defendant Hyde selected as giving the whole basis of flotation concentration (Opinion, p. 2). The Supreme Court cites it as disclosing a process for utilizing the affinity of oil for metals (Opinion, p. 2) and cites it again as disclosing increase in the selective property of oils by the use of acid (*idem*). No further identified specific mention is made of this patent by the Supreme Court. It is undoubtedly included in the general classification as a process which

“consisted in mixing finely crushed or powdered ore with water and oil, sometimes with acid added, and then in variously treating the mass—‘the pulp’—this formed so as to separate *the oil, when it became impregnated or loaded with the metal and metal-bearing particles* from the valueless gangue” (Opinion, p. 2).

The Supreme Court then classifies all of these patents, including the Everson into either a “surface flotation process” or a “metal-sinking process.” The first class is stated to depend upon oil-buoyancy for carrying the metal to the surface. There is no specific statement as to which of the five alleged anticipations are included in this class, although obviously it includes four of them, Froment, Glogner, Schwarz and Kirby. The other alleged anticipation considered by the Supreme Court and principally relied upon by the defendant was the Everson patent. It does not depend upon oil-buoyancy for carrying the metal *to the surface*. Its *first method*, wherein a little over 5% of oil is used (Liebmann, Vol. 3, p. 742) is clearly and admittedly a procedure wherein all of the particles of the metal are agglomerated by oil (in this case a com-

pound including oil) into a pasty mass or masses from which the gangue is separated by washing it out (Sadtler, Vol. 5, p. 2780; pp. 2843, 2844, Vol. 7, p. 3611). Its *second method* wherein 17 or 18% of oil is used (Liebmann, Vol. 3, p. 742; Sadtler, Vol. 5, p. 2845) does not employ sufficient oil to float the metal *to the surface* by oil buoyancy. In this second method the oil *lightens the metalliferous mineral* and “*the sand and mineral are merely transposed or their relative positions are reversed*” (Vol. 4, p. 2058, Everson Spec., p. 2, lines 108, 109) from the ordinary conditions which then prevailed in the “wet separation of ores” (Everson Spec., p. 2, lines 113, 114), so that the mixture of oil and mineral was removable, as Everson says, by “devices and methods now well known in wet separation of ores” (Everson Spec., p. 2, lines 105, 106). This Everson said could be accomplished “by means of a constant overflow of water from a washing out vessel” (Everson Spec., p. 2, lines 102-104). In testing the process plaintiff’s experts at the time of the Hyde suit tried a washing out vessel such as was used in Everson’s day for classifying the ore (and not for concentrating the ore) with an up current of water to carry away the mixed oil and metal in suspension, but the results were wholly unsatisfactory (Liebmann, Vol. 2, pp. 539, 540; Chandler, Vol. 3, pp. 872, 873; Higgins, p. 927, Q28). As Dr. Chandler says “the separation was a complete failure” (p. 873) and the assay of his test showed tailings richer than the original ore and concentrates leaner than the original ore (p. 927). This was disappointing. Finally, however,

after the closing of testimony in the Hyde suit, it was found that if the operation of separation were performed in a miners' washing pan or batea a fair concentration and substantial recovery were attainable (Higgins, Vol. 8, pp. 4464, 4467, Qs24-37). This experiment was performed at the present trial (pp. 4473, 4474, Qs57-60) and resulted in concentrating material containing 4.64% of copper to 12.8% of copper with a recovery of 53.8% of the metal (Vol. 9, p. 5562). This was contrasted with an ordinary operation of wet separation carried on in the batea wherein the sand was carried off in suspension in the overflow over the edge of the vessel, and the metal remained in the vessel (p. 4467, Qs38-40, and following cross and direct examination to Q58). Both experiments were representative of what would occur in a large operation on a shaking table such as was used in the wet concentration of ores at the time of the Everson invention (p. 4465, Q29), and the two experiments well illustrate Everson's statement that she reverses ordinary water concentration, and the experiment with oil demonstrates the possibility of a reasonable concentration even though with heavy losses in accordance with the disclosure of the Everson patent. In both experiments the escaping material overflows in suspension in the overflowing water. According to Everson the overflowing material is a mixture of oil and metal. With water concentration the overflowing material is sand. The fact that Everson's specified proportions exactly fit the standard batea (p. 4466, Q31) tends to confirm the view that appellees' experts have reproduced the identical experi-

ment which Mrs. Everson performed in her laboratory at the time of the making of the invention.

These batea experiments were repeated before the Supreme Court of the United States, with the consent of the Justices, after a statement had been made that they were not in evidence in the Hyde suit, but repeated experiments made in the Miami suit. This court did not see them, and they were not in the Hyde Record.

In view of the fact that wherever one material is separated from another by an overflow or upcurrent (Higgins, p. 4477, Q77) it sinks relatively to the overflow or upcurrent which carries it away, it would seem reasonable to conclude that the Supreme Court of the United States included the Everson second method as well as the Everson first method in its general class of metal sinking processes. Certainly the recovery of sand by overflow in ordinary ore concentration would not be a sand flotation process (Higgins, pp. 4476, 4477, Qs69-77), and therefore the recovery of mixed oil and metal under exactly similar conditions and with similar carrying off of the substance separated in suspension would not be a metal flotation process, and the term used by the Supreme Court "surface flotation process" is not applicable to either of these procedures.

Mr. Higgins gave several references to the literature of the days preceding the Everson invention wherein the word "floated" is used to describe the flowing off in suspension of particles heavier than water (p. 4477 et seq., Qs78-83; Qs92-95). This fully explains the use of the words "floated off" in her statement "by which

overflow the concentrate will be floated off'' (Everson Spec., p. 2, lines 104, 105), this statement being followed by that as to devices and methods then well known in wet separation of ores, and that ''the sand and mineral are merely transposed or their relative positions are reversed'' (Everson Spec., p. 2, lines 107-110).

The Supreme Court having decided that the Everson patent does not anticipate the patent in suit, it would seem to be unnecessary to give further consideration to that patent, and indeed the appellant did not at the trial of the present case attempt to demonstrate that in any apparatus known at the time of the Everson patent and then used in the wet concentration of ores it could carry out what its experts and the expert of the defendant in the Hyde suit put forward as their view of the Everson process. Appellant's testimony was confined to a reference to churns, oil-purifying apparatus, spitzkasten for classification with slime overflow, and dollies or mixing tubs, as apparatus that might possibly be used to carry on the Everson second method. One of these devices, called the ''Cataract Machine,'' an oil purifying device, was altered so as to make it possible to carry on in it a very violent agitation which abundantly aerated an ore pulp and with the use of an oil which apparently was a kerosene contaminated with a soluble frothing agent. It is to be remembered that the oil of Everson's second method was a petroleum oil only slightly heavier than kerosene, which cannot produce a froth, and that even for the production of an inflated oil mass or magma by

terrific agitation, the presence of a soluble frothing agent is necessary.

Cataract Oil-Purifying Machine.—This oil-purifying machine is described in a book by Andes published in 1882. In operation, by stirring, a circulation is established, outward in the lower part of the vessel, upward near the walls of the vessel and back into the middle. The description says:

“The oil therefore makes a circuit and during this circuit there is so intensive a mixing and so powerful an agitation, and thereby so intimate a bringing in contact with the atmospheric air as can be obtained by no other machine and can be accomplished in no other way” (Vol. 5, p. 2853).

This is a description of such a stirring as constantly exposes new surfaces of the oil to the air. Probably the device was quite effective, operating in this manner, in the purification of oil. It is also said to be useful in mixing dry color with lacquer for making varnishes. Obviously it was never operated at such a speed as to beat the oil or varnish into a foam or froth. This would have been highly objectionable and the machine was not so constructed as to permit it to occur.

Obviously Mrs. Everson did not intend to include any such device in her statement as to the manner in which her process was to be carried out in practice, as follows:

“A proper selection of devices for this purpose will be apparent to those skilled in the wet separation of ores” (Everson Spec., p. 2, lines 112-114).

If, therefore, it were possible in this oil-purifying device to replace the oil by an ore pulp, and by carrying on the operation which had characterized the device in the purification of oils to carry on in it the Everson process, that fact would be wholly irrelevant because it would be no part of the disclosure of the Everson patent.

In fact, however, appellant did not reproduce this Andes cataract machine and did not carry out in this cataract machine, with an ore pulp, the operation which characterized that machine. Appellant altered the oil-purifying device materially for the purpose of adapting it to what appellant wished it to do, and then carried on in it an operation wholly different from any operation such as characterized the apparatus disclosed. An examination of the drawing (Plaintiff's Exhibit 254), showing in contrast the cataract machine as disclosed by Andes and the so-called cataract machine as constructed by the appellant's experts, very clearly shows that the Andes machine as disclosed would not do what appellant wanted it to do and therefore appellant made a wholly different machine to accomplish its purpose of misrepresentation.

FRYER HILL PUBLICATION.

This document (printed, Vol. 3, pp. 1006-1008) was put in evidence by the complainants in the Hyde suit, after having been referred to in the cross-examination of Mr. Ballantyne and described by him as stating that experiments were being made "with a bulk oil process

for the concentration of dry silicious ores'' (Vol. 2, pp. 459, 460, XQ117). Defendant's witnesses did not refer to it in that case. It fails to give a definite disclosure of any process. The name Everson does not appear in the publication. The description indicates that whatever it attempted to describe was a bulk oil or an oil-buoyancy flotation process. If it describes anything which grew out of Mrs. Everson's invention, then it shows that Mrs. Everson advanced to the point of oil-buoyancy flotation, thereby anticipating Elmore. In fact, however, the disclosure cannot anticipate anything as it does not make a full disclosure of any process.

There is not a word of evidence connecting this publication with Mrs. Everson. In commenting upon this disclosure Dr. Liebmann said that there were several facts appearing in the description which induced him to believe that this extract referred to an experiment according to the Everson patent (Vol. 2, p. 546, Q8), and Dr. Chandler said that it "describes an effort to use a process resembling the Everson process on silver ores" (Vol. 3, p. 873). Both are in agreement that no clear disclosure is contained in this document of any process. At the present trial appellant produced a wonderful product of the ingenuity of appellant's counsel which was alleged to be such a machine as is described in this publication, and operated it at a speed between 1400 and 1500 revolutions a minute (R., Dosenbach, p. 1216, Q31), and by this terrific agitation and the employment of an oil which was probably a kerosene contaminated by a soluble frothing agent, succeeded in producing a float containing a fair amount of metalliferous mineral.

Everything about this experiment was ridiculous. The character of the agitation is indicated in the publication by the description of the agitator as *arastra*-like, as well as by the description that the agitation keeps "the whole mixture in motion." The character of the result is indicated by the fact that it causes "the mineral-charged oil to float," and the statement that the oil is "laden with its precious freight" and the repeated further description of the product as "mineral-laden oil." The disclosure calls for the use of steam introduced at the bottom of the mixture and the injected steam in connection with the revolving device are said to jointly contribute to cause the "mineral-charged oil" to float. The appellant's operation of its spurious machine was a violent agitation for the purpose of aeration with no attempt whatsoever to utilize steam. This operation is well characterized by the testimony which Dr. Sadtler admits that he gave in cross-examination in the Miami case (Vol. 7, pp. 3688-3690) describing a similar operation of a similar machine (Dosenbach, Vol. 6, pp. 3398, 3399, XQs371-376) in which Dr. Sadtler said that there was nothing in this publication which defined the nature of the agitation, that the specific description therein was "a very vague statement," that the publication contained no directions as to the quantity or proportion of oil to be used or as to the speed of agitation or directions representing any definite mechanical structure, and finally that the "very vague outline of this newspaper article is entirely compatible or in accord with what could be done." The law is well settled that a disclosure relied upon to anticipate an invention

“must be an account of a complete and operative invention capable of being put into practical operation.”

The above language is quoted from *Seymour v. Osborne*, 78 U. S. (11 Wall.), 516, 555. Obviously the Fryer-Hill publication does not disclose a mineral-froth-producing process.

CRILEY-EVERSON PUBLICATION.

This document (printed Vol. 3, p. 1009) was put in evidence by the complainants in the Hyde suit (Vol. 2, p. 460). Defendant's witnesses did not refer to it in that case. It was well described by Dr. Sadtler in the Miami trial, as admitted by him, as follows:

“It does not, as a disclosure, give enough details to make it possible to carry it out in a definite and accurate way. It leaves entirely too much to chance” (Vol. 7, p. 3691).

In the present case the extent of appellant's reliance upon this publication as stated by Dr. Sadtler was that it contributed

“only a picture of results of the account given in the Fryer-Hill publication” (p. 3782, RQ571).

This publication received the most careful consideration in the Privy Council case, *Ore Concentration Company, Ltd., v. Sulphide Corporation*, 31 R. P. C. 206. Lord Parmoor says:

“To this extract the attention of their Lordships was directed in considerable detail” (*Hyde Supreme Court Record*, p. 749).

And further :

“Even if the test process is not to be discarded as a failure, it does no more than give information that if to a greased mixture of pulverized metal and rock you add boiling sulphuric acid in a sufficient quantity of water, in some way a differentiation is effected as between the metal and the gangue” (*idem*, pp. 749, 750).

The absence of any statement in this publication as to the amount of oil used makes it impossible to affirm or deny that there was sufficient oil for oil-buoyancy flotation. The character of the oil used, however, described as “black thick oil,” indicates oil-buoyancy flotation. The statement as to the result, the flotation of “a thick scum of sulphurets” (sulphides) also indicates oil-buoyancy flotation, since the floating mass of oil and ore of the Elmore process well responds to that description. Nevertheless, in the Privy Council case it was rejected as not sufficiently definite to anticipate the Elmore process.

It was significant, in the Hyde suit, that although Dr. Byrnes, defendant’s expert, admitted that he knew of this publication (Vol. 4, p. 1594, XQ88) he did not refer to it in his attempt to establish anticipation of the process in suit.

The only specific reference to this publication in the opinions in the Hyde suit was in that of this court, wherein it is joined to the Everson patent (214 Fed. 106).

In reversing the decree of this court, the Supreme Court did not refer to this Criley-Everson publication. Obviously no new statement of the law was required,

and a mere reading of the publication must lead to its rejection as not being "an account of a complete and operative invention capable of being put into practical operation" (Seymour v. Osborne, 78 U. S., 516, 555).

ELMORE PATENTS.

There are four of these patents in evidence, two for process and two for apparatus. Only the process patents need be considered.

The first process patent No. 676,679 of June 18, 1901, to F. E. Elmore (printed Vol. 4, pp. 2089-2092), discloses oil-buoyancy flotation. The amount of oil usually required is from 100% to 300% of the ore, although the latter figure in fact describes the total amount of oil used in three successive operations, which may be largely or wholly the same oil used over again after separation from the concentrate by a centrifugal separator. The agitation is of a very gentle nature and as carried on in the laboratory consists in carefully tipping a glass bottle or vessel containing the mixture about fifteen times, so that in each tipping operation the ore will flow downward and the oil upward, and metal particles will become entrapped in a floating mass of oil. This laboratory operation was described by Mr. Chapman in the Hyde suit (Vol. 2, pp. 287-289, XQs124-126). This Elmore specification well describes the essential operation as follows:

"Then agitate the mixture without breaking up the oil into small globules. The metallic particles will adhere to the oil and be buoyed up and floated by it, while the

other constituents of the ore will remain in the water” (Spec., p. 1, lines 41-46).

The metal-carrying floating layer of oil is floated off and submitted to centrifugal action to separate as much as possible of the oil from the metal, and the oil is pumped back to a cistern for re-use, care being taken to keep air bubbles out of it. The specification says:

“In order to clear the oil from air bubbles I prefer to draw the oil up to the cistern by creating a partial vacuum in the cistern” (Spec., p. 1, line 104; p. 2, line 3).

The other process patent No. 689,070 of December 17, 1901, to A. S. Elmore (printed Vol. 4, pp. 2093-2095) merely adds to the first patent the use of acid, which

“greatly enhances the selective action of the oil” (Spec., p. 1, lines 29, 30).

This patent does not repeat all the details of the F. E. Elmore patent, and particularly does not repeat the limitation of that patent to the use of thick oil. In fact, the specification is quite indefinite, and this very indefiniteness accounts for the fact that, upon the British and the Australian patents corresponding to it, the great litigations which ended in the House of Lords and the Privy Council were carried on in the effort of the Elmorees to dominate air-froth flotation by their patent for oil-buoyancy flotation.

The Elmore process reached the mill and was a hope of the metallurgical world in 1903. It was proved in the Hyde suit that it was tried at the Traversella Mine in Italy, where Froment was the engineer (Ballantyne,

Vol. 2, p. 433). Kirby refers to the Elmore process in his specification (Vol. 4, p. 743; Spec., p. 1, line 102; p. 2, line 3), as admitted by Dr. Sadtler (Vol. 7, p. 3733, XQs419, 420).

In Richards' Ore Dressing, Volume 1, published in 1903, the Elmore process under the heading of "Adhesion" is referred to as of possible use where ordinary wet concentration "altogether fails," because there is not sufficient difference in the weight between the mineral and gangue (Fulton, Vol. 8, pp. 4398, 4399).

Finally in November, 1903, three post-graduate students of the California University published an excellent description of the Elmore process as in use and of their laboratory experiments with it, which is in evidence as Defendant's Exhibit 47, California Journal of Technology. This article starts with "a brief outline of the process as it is in actual operation" (Vol. 9, p. 5036) "and now in successful operation" (p. 5037) and with an illustration of a large scale plant following closely the lines of the patent drawings.

The Elmore process was characterized by the Circuit Court of Appeals of the Third Circuit as one of the two "mill failures" in the efforts of the prior art to utilize oil in ore-concentration (Opinion, p. 8), the other mill failure being Cattermole.

FROMENT PATENTS.

These patents in the order of their dates are first, the Italian patent No. 63,723, dated May 20, 1902, the

latter being conceded to be the date at which it may be treated as effective (printed Vol. 3, pp. 1216-1218; translation, pp. 1218-1221), and then the British patent No. 12,778, dated June 4, 1902 (that being merely the date of the filing of the provisional specification) and effective as a patent as of its sealing date, which is stipulated to be August 18, 1903 (Vol. 2, p. 625). This patent was granted to Lake, a British patent agent, as a communication from Froment (printed Vol. 4, pp. 2196-2198).

Briefly the Froment patents describe a test tube experiment with 10 grams (two-fifths of an ounce) of ore, at least 11.7% of oil (234 pounds to the ton of ore), which in a brief agitation carried on for one second of time produces a floating magma of oil which carries metal particles in its mass and is inflated by gas bubbles. This floating magma diminishes in bulk and drops most of its metal when agitated for another second and is completely broken up and drops all its metal with a few seconds of agitation. This "metallic magma," as Froment designates it, looks like a froth, but is wholly different in structure from a froth such as characterizes the process in suit. It is not an assemblage of air bubbles carrying metallic particles in their films, but a mass of oil carrying metallic particles, this mass of oil being lightened by entangled gas bubbles, and thereby made light enough to float and unreliably carry a fair amount of metal, but with the metallic particles distributed through the oil and not attached to the air bubbles at all. For air in oil has no attraction for metallic particles (Vol. 8, pp. 4566, 4567; pp. 4225-

4229, Qs44-47). The production of Froment's magma is an interesting laboratory experiment, but the procedure never got beyond the laboratory and a magma of oil and metallic particles lightened by air bubbles such as Froment produced has never been of the slightest value in the concentration of ores.

The Italian patent describes the agitation in the only example of either specification, to wit, *a test tube experiment employing three-fifths of an ounce of ore, as one wherein the mixture is*

“agitated for a second” (Vol. 2, p. 1219),

whereas the British specification, reflecting the caution of a British patent agent, says:

“agitated for a brief space” (Vol. 4, p. 2195, line 37).

It may be noted that where at a later point in the specification the entire operation of completely separating the metalliferous particles from the gangue, including agitation and settling, are described, both the Italian and British specifications are in agreement in saying that this requires “only a few seconds” (Vol. 3, p. 1220; Vol. 4, p. 2196, line 4).

Another difference between the two documents is that the British patent contains a reference identifying the invention in its relation to the prior art, as customary in all British patents. This is as follows:

“This invention has reference to the concentration of metalliferous ores and earths for the purpose of separating and recovering therefrom the finely divided metal or metallic compounds, and consists of a modification of what is known as *the oil process of ore concentration*” (Vol. 4, p. 2195, lines 17-20).

The only process known as "the oil process of ore concentration" in 1902 and 1903 (the complete specification was filed March 4, 1903) was the Elmore oil-buoyancy flotation process (Ballantyne, Vol. 2, p. 433; Liebmann, p. 626; Chandler, Vol. 3, p. 891). Mr. Ballantyne, in the testimony above cited, also testifies that the Elmore process had been tried at the Traversella Mine in Italy, where Froment was the engineer, and this testimony is uncontradicted, so that the evidence leaves no question but that the Elmore process was here referred to. When, later in the specification the oil used is described as "ordinary oil" p. 2195, line 35) there can be no doubt that the ordinary oil of the Elmore process, to-wit: heavy petroleum, is the oil thus referred to. Further, *the only oil named in any Froment document is "mineral engine oil"* (Froment description, Vol. 3, p. 1000), *which is the heavy petroleum of Elmore.*

The quantity of ordinary oil described in this specification is "a thin layer" (p. 2195, line 36) and the thinnest possible layer of such an oil that could be formed in a test tube such as would be used for carrying on the experiment described with its ten grams of three-fifths of an ounce of ore and thirty grams or about two ounces of water, would amount to 11.7% of the ore with the thinnest of these residuum oils, the other usual Elmore oil requirements 14.4% of oil to make a layer on water in such a test tube (Chandler, Vol. 3, p. 887; p. 911, Q126). Dr. Liebmann's determination of the least quantity of such an oil was 12½% (Vol 2, p. 634), and Mr. Chapman determined it as 12.6% (Vol. 3, p. 941). Dr. Liebmann's determination

also included the oils which defendant's expert, Dr. Byrnes, considered as falling under the Froment specification (Vol 2, p. 834), and these oils were olive oil, cottonseed oil and oleic acid (Vol 4, pp. 1520, 1521, 1528, 1529). Olive oil is Dr. Sadtler's interpretation, presented with elaborate explanation, but accompanied by the statement that the language of the specifications

“does not give a definite description of the kind or amount of oil, but *we can make a guess* at how much he meant and what was the character of the oil” (Vol. 7, p. 3618).

Therefore as to all of the oils which defendant's experts in the Hyde suit or in the present suit have stated to be described by Froment, 12½% of oil is the smallest amount which will form the thinnest possible layer in the Froment disclosed experiment. In the trial of the present suit Dr. Sadtler, by warming the water, got about 9% of olive oil to just form a layer (Vol. 7, p. 3622), but obviously this was unjustified, as indeed he admits that there is no reference to heat in the Froment patents (Vol. 7, pp. 3768-3769, XQs546, 547). Further we have no right to assume that when Froment described the amount of oil that he used as “a thin layer” he meant the thinnest possible layer that could in any event be obtained. Without question his standard of comparison was the Elmore process. The Elmore layer under like conditions with 100% of oil is one inch thick (Chandler, Vol. 3, p. 879). A thin layer as compared with this might well be of substantial thickness, not less than one-eighth of an inch thick (Liebmann, Vol. 3, pp. 851, 852, RQ224). The absolute minimum of the thinnest possible layer with

ordinary oil of the oil process of ore concentration, 11.7%, can hardly be taken as Froment's recommendation. However, with this absolute minimum, Dr. Chandler exactly reproduced what Froment describes (Vol. 3, pp. 891, 892, Experiment 1). He shook the test tube for one second and obtained a magma one inch thick with fairly clean tailings at the bottom of the tube. He shook the test tube another second and the magma diminished to half an inch in thickness and much of the metal subsided. On the fifth repetition of this agitation the magma diminished to one-fourth its original size and was nearly all oil (p. 892).

As a further test using another oil, not disclosed by Froment, oleic acid, he used 1.6 cc. of 14.4% of oleic acid, just enough to form a layer, shook it for a second, and obtained a good half inch of magma, and repeated the operation as before and destroyed his magma, leaving nothing but a few clean bubbles and a little mineral floating by surface tension (pp. 892, 893).

These two experiments in the Hyde case remain uncontradicted as to operations or results in the case at bar. The first of them gives all that Froment disclosed to the world in his patents. At the trial Dr. Sadtler diminished his acid component to two drops, five drops being the minimum used by all other experimenters in this record, warmed the water to 37° Centigrade, or nearly 99° Fahrenheit (although he admitted that there was no mention of warming in the Froment patents) (Vol. 7, pp. 3768, 3769, XQs546, 547), used 9% of olive oil (which is not enough to form a layer unless the water is warmed), and by agitation for several

seconds produced a float which no one measured and which he called a froth (Vol. 7, pp. 3634, 3635, Qs184-187). This was not an experiment according to the Froment patents or anything else in the prior art.

It is interesting that the full amount of sulphuric acid which would be required to decompose the gram of limestone specified by Froment is 1 gram, or from 23 to 32 drops (Chandler, Vol. 3, p. 586; accepted by Dr. Sadtler, Vol. 7, p. 3617), and that Froment suggests limiting the violence and explosiveness of the reaction, not by diminishing the amount of sulphuric acid, but by avoiding the use of limestone "in excess" (Vol. 4, p. 2195, line 40). Reduction in the amount of sulphuric acid is not therefore in accordance with the disclosure.

As a single example of careless statement amounting to a misrepresentation on the part of Dr. Sadtler, we may note that in attempting to justify his diminution in the amount of sulphuric acid used, he quotes Dr. Liebmann's testimony (Vol. 3, p. 768; XQ62) describing an experiment made for the purpose of showing that Dr. Byrnes' spurious Froment operations were unjustifiable, and then says that he (Dr. Sadtler) "would not go quite that far" (Vol. 7, p. 3631). In cross examination he was finally led not only to admit that what he had quoted as interpretation of Froment was not interpretation of Froment, but also to criticize Dr. Byrnes' spurious experiments alleged to represent Froment by stating that he would not "illustrate the Froment experiment that way" (Vol. 7, pp. 3745-3749, XQs468-476).

The effort of the present appellant to misrepresent the Froment disclosure is quite in line with what was done by the defendant in the Hyde suit, but the whole subject of Froment was disposed of by the Supreme Court decision in the Hyde suit.

Supreme Court Decision as to Froment. Mr. Justice Clarke makes several references to Froment's total contribution to the knowledge of the art. He refers to the Froment British and Italian patents as among the patents finally relied upon by defendant as anticipations (Opinion, p. 2), and again refers to the Froment British patent as one of the two patents selected by the defendant Hyde, as giving the whole basis of flotation concentration (*idem*). The only further specific reference to Froment is as follows:

“Froment Great Britain patent (1903) and the Kirby United States patent (applied for in 1903 and granted in 1906) are especially suggestive of the advance which was being made to the desired result, but the Froment process was little more than a laboratory experiment and has never proved of value in practice” (Opinion, p. 4).

This dismissed the Froment patents and the Froment description, next to be considered, as “little more than a laboratory experiment” and as merely suggestive of advance towards the invention in suit, tending to diminish it may be, the length of the step which the patentees took from Elmore, a workable flotation process, to the process in suit, which “converted experiment into solution, ‘turned failure into success’” (Opinion pp. 7, 8), and wholly failing to anticipate the invention in issue.

The analogy is close between the case at bar and the Telephone cases (126 U. S. 1). There Reis had invented, widely published, and used a device for reproducing sound, which conveyed musical tones. Its fault was that the vibrations of the diaphragm opened and closed the electric circuit. By a trifling adjustment, the tightening of a screw, or the stiffening of a spring, it was possible to prevent the opening and closing of the circuit and to obtain the unbroken electrical undulations which characterized Bell's invention. This last step he failed to take. After the Bell invention had been made and published the Reis instrument was adjusted so that it transmitted speech. The prior art disclosed every detail of the Bell invention except the one point of adjustment so that the current would not be broken (126 U. S., pp. 539-545). As Mr. Chief Justice Waite said:

“Under such circumstances it is impossible to hold that what Reis did was an anticipation of the discovery of Bell. To follow Reis is to fail, but to follow Bell is to succeed. The difference between the two is just the difference between failure and success. If Reis had kept on he might have found out the way to succeed. He stopped and failed. Bell took up his work and carried it on to a successful result” (p. 545).

Again contrasting the work of Reis and that of Bell the court says as to Bell's process patent:

“His patent would be quite as good if he had actually used Reis' apparatus in developing the process for which it was granted” (p. 540).

With Bell's invention the practical art of telephony commenced. With the invention here in suit the practi-

cal art of air-froth flotation concentration commenced. Both inventions were founded upon discoveries which took the final steps that converted experiment into solution, turned failure into success.

FROMENT DESCRIPTION.

This private document (printed Vol. 3, pp. 990-996; translation, pp. 996-1005; drawings, pp. 1312, 1313) was voluntarily produced by Mr. Picard from the files of Mineral Separation, Ltd., during his testimony as a voluntary witness for defendant in the Hyde suit (Vol. 4, p. 1708), and thereafter put in evidence by complainants. It was so fully considered in the opinion of the District Court in the Hyde suit (207 Fed. 958-962), that the Supreme Court merely refers to it generally in its characterization of the Froment process as a disclosure which "has never proved of value in practice" (Opinion p. 4). In the Miami suit it was fully considered, upon "voluminous and conflicting" evidence, and dismissed by Judge Bradford (237 Fed. 626, 627). The Circuit Court of Appeals for the Third Circuit did not specifically refer to it.

The disclosures of this private description and all the circumstances connected with them were fully presented and explained in the Hyde record, and upon that record the Supreme Court of the United States has found no anticipation of the process in suit. The voluminous evidence on the same subject in the Miami record was not presented to this court by the defendant. In fact, in the case at bar no demonstrations were made pur-

porting to represent these disclosures, and there was no testimony of any moment in regard to them. It is, therefore, deemed unnecessary to again present the arguments on this subject heretofore fully considered by this court and approved by the Supreme Court of the United States.

When the Hyde case was argued in this court the counsel for Hyde exhibited a demonstration alleged to represent the Froment description. There was no foundation for this demonstration in the evidence. The defendant in the Hyde suit did not (nor did the appellant here) put in evidence an experiment even alleged to represent the Froment description. We have no hesitation in characterizing the demonstration made in this court in behalf of the defendant Hyde which was alleged to represent the Froment description, as a sham and a fraud, and the fact that it was not repeated in the Supreme Court, and especially that it was not repeated at the trial of the present suit, at which all materials and results were subjected to chemical analysis or assays, would seem to establish the truth of our assertion. This court was informed by counsel for Hyde that the Froment description disclosed a froth flotation process wherein the use of one per cent. of oil was suggested as the minimum. *The fact is that the Froment description did not disclose a froth flotation process at all.* Aside from all other considerations the oil of the Froment description was mineral engine oil (Vol. 3, p. 1000, line 7), a heavy petroleum non-frothing oil, the oil of the Elmore process, incapable of effecting the recovery of metalliferous mineral in a froth. That fact

was not proved in the Hyde suit but is fully proved in the suit at bar.

CATTERMOLE PATENTS.

Cattermole Patent No. 777,273. In the Hyde suit the defendant put in evidence the principal Cattermole patent No. 777,273 of December 13, 1904 (printed Vol. 4, pp. 2136-2140). This patent was exhaustively considered in the Hyde case. It is briefly and accurately described in the opinion of the District Court in the Hyde case (207 Fed. 957, 958). It was referred to in the Supreme Court opinion as one of the patents disclosing the advantage of the use of acid in addition to oil (Opinion, p. 2), and selected by the Supreme Court as the example of the "metal sinking process" (Opinion, p. 3). It was again referred to by the Supreme Court as a process upon which the inventors of the process in suit were at work when they discovered the process in suit (Opinion, p. 4). Obviously the Supreme Court has construed it as disclosing a metal sinking process and not disclosing a metal-froth-forming process in any respect whatsoever.

In the trial of the case at bar appellant merely performed a hybrid experiment in which Cattermole was practically spoiled and the process of the patent in suit impaired. The amount of oil used was 1½% of the weight of the ore (Dosenbach, Vol. 6, p. 3333, Q83), and by reason of the low metalliferous mineral content of the material used this was about 7% of the metalliferous mineral (p. 3334, Qs91-94). Agitation was carried on

at 1450 revolutions per minute (Q102), and a mineral float was formed which was a low grade mineral froth (42.60% zinc; Vol. 9, p. 5543), weakly holding the mineral particles. The operation was then repeated at the slow speed of 300 revolutions per minute (p. 3336, Q103), but with other conditions the same, and this resulted in separating the air bubbles from the metalliferous mineral particles by centrifugal action without aeration so that the metalliferous mineral particles sank (Q106). Then the Gabbett was speeded up to about 1450 or 1500 revolutions (Q115, 116), and the result was a similar froth of still lower grade (40.70% zinc; Vol. 9, p. 5543). Then the machine was rotated at the slow speed of 300 revolutions per minute, and the air bubbles again separated from the metallic particles (p. 3340, Q126). Then the metalliferous mineral particles were separated in an upcast (*idem*).

The result of this hybrid experiment was that the separated metalliferous mineral particles which sank in the upcast, to some extent agglomerated together, but not by any means into well formed granules. The difference in specific gravity between mineral and gangue, about $4\frac{1}{2}$ to $11\frac{1}{2}$ (Higgins, p. 4530, Q332; p. 4781, RQ244), was sufficient to account for the upcast separation without honestly carrying out the Cattermole process.

A comparison is instructive of the assay results of this alleged Cattermole experiment, concentrates 32.70% of zinc and 35.60% of insoluble or gangue, tailings 3.90% zinc (Vol. 9, p. 5543) (78 pounds of zinc going to waste in each ton of tailings), with Mr. Higgins' genuine Cattermole experiment with the same ore, con-

centrates 56.63% of zinc and 2.53% of insoluble or gangue, tailings 1.99% zinc (Vol. 9, p. 5562). Mr. Dosenbach's results show that he was not carrying on a metallurgical process but merely juggling with hybrid conditions.

It is to be noted that in 1905 it was determined that for carrying on the Cattermole process

“speeds of rotation (with a small Gabbett) varying from 3 [hundred] to 500 revolutions per minute proved almost useless” (Sulman & Picard Report March 3, 1905, Vol. 3, p. 1100),

and that Mr. Higgins' tests reported March 2, 1905, as to the effect of variations of speed in the Cattermole process covered a range of from 840 to 1462 revolutions per minute. This speed of 840 revolutions per minute is the slowest speed described as producing any result in all of the Sulman and Picard and Higgins' reports. The appellant therefore in selecting 300 revolutions per minute as a speed for a Cattermole operation, selected a useless speed, and obtained in fact a centrifugal action for separating air bubbles from metalliferous mineral particles. And by increasing the amount of mineral-froth-forming oil to 1.5% on the ore he so weakened the attraction of air bubbles for the mineral particles that his froth was easily destructible.

Mr. Higgins properly criticizes this experiment and says that it did not produce granules at all, but merely possibly some attachment between coarse mineral and fine mineral which might be called agglomeration, but in no sense granules (Vol. 8, p. 4529, Qs329, 330), and that the centrifugal action resulting from the low speed pro-

duced centrifugal separation (Q331) and that the operation was not a carrying on of the Cattermole process (Q333). This was repeated in cross-examination (pp. 4760-4765, XQs145-173).

Mr. Higgins carried on the Cattermole process in a Gabbett in accordance with the disclosures of the Cattermole patent, using a rather large percentage of oil, by reason of the very finely ground condition of the ore, 5% on the ore and about 15% on the metalliferous mineral (p. 4526, Qs315, 316). He stopped at the conclusion of the agitation to show that no froth was formed (Qs 323, 324). The speed of revolution was about 850 revolutions per minute (Q315) and the recovery was 93.6% in a high grade concentrate containing 56.63% of zinc and only 2.53% of insoluble or gangue (Vol. 9, p. 5562).

Contrasting this experiment with Mr. Dosenbach's series of manipulations with 1½% of oil to ore (in the absence of the assays not then produced) he says that the results showed that for this operation in a single Gabbett and with a single upcast the proportion of 15% on the mineral and 5% on the ore was an excellent proportion to take (p. 4530, Q336) and that the production of the Cattermole result is the proper criterion for the determination of the right amount of oil to use (Qs337, 338) and that you cannot arrive at the proper proportion as a matter of mathematics because Cattermole gives his oil proportions as dependent on no less than seven different factors, and does not give the different rates at which the oil varies with these factors so that

it is quite impossible to calculate the amount of oil you should use (Q340).

The statement that the Cattermole patents recommend a proportion of oil which, with lean ores, would be less than one per cent. of the ore, is and has been throughout the entire American litigation a favorite fiction of counsel for defendants, and this fiction is repeated in appellant's brief (p. 9). Counsel for defendant in the Hyde suit so stated in this court and in the Supreme Court of the United States, and the Supreme Court in its decision called attention to the reference in the Cattermole patent to 10% on the metalliferous mineral (Opinion, p. 3). The fact is that Cattermole directs the user to determine the proper amount of oil by actual tests, stating seven factors, viz: (1) kind of oil, (2) viscosity of the oil, (3) fineness of the ore, (4) the nature of the metalliferous mineral in the ore, (5) the nature of the gangue in the ore, (6) the relative proportion of gangue to mineral and (7) the consistency and size of mineral granules desired, with the general statement that there are "other factors" (p. 2138, lines 64, 65), and says that the proportion of oil should be "kept within reasonably low limits, differing in different cases," etc. (p. 2137, lines 9, 10). The standard of the art in his day was Elmore, requiring at least a ton of oil to a ton of ore. With all these qualifications, he suggests that usually an amount of oil varying from 4% to 6% of the metalliferous minerals will give suitable granules, but in the same paragraph mentions 10% as a proportion which will produce granules. Then he cautions the user that a lean ore must be enriched

or in some way provided with an increased amount of metalliferous or other matter having an affinity for oil (p. 2139, lines 34-43). Obviously the only method of determining the proper amount of a given oil for use with a given ore, is that of trial. Mr. Higgins has found, as above noted, that with appellant's ore in the finely ground condition used, 15% on the metalliferous mineral (5% on the ore) gives excellent granules. Appellant has failed to give a single example of the carrying out of the Cattermole granule-forming metal-sinking process with less than one per cent. of oil to ore. In fact there is no evidence that the appellant's experts ever carried on the Cattermole process with any percentage of oil. In the Hyde case defendant's expert, Dr. Byrnes, merely theorized arithmetically. In the present case Mr. Dosenbach carried on an experiment that did not produce granules. In practice the standard of the Cattermole process was 5% of the metalliferous mineral in an ore containing upward of 50% of metalliferous mineral (Chapman, Vol. 2, pp. 240, 241, Q9). This was upwards of 2½% on the ore, 50 pounds or more to the ton of ore. In the laboratory smaller amounts were sometimes used, but never less than 1½% on the ore.

In the argument of the Hyde case before this Court counsel for defendant Hyde asserted that the Cattermole process consisted of two stages, first a violent agitation, which produced a froth, and then a slow smooth stirring, which sunk the mineral. This argument was ingeniously fabricated upon the facts that the Cattermole patent 777,273 shows a two-stage agita-

tion (but with both stages of the same intensity, and an intermediate recovery of everything that sank and a loss of everything that floated), and that as the Cattermole process developed in the laboratory, it was found advantageous to employ a first and violent agitation, which produced sinking granules, followed by a second and slower agitation which completed the conditions for final separation by sinking the granules (Chapman, Vol. 2, pp. 238, 239). *In both instances, however, the agitation of the first stage was immediately followed by separation in an upcast which would have carried away to waste any mineral froth, and which saved for further use in the process only the material that sank in the upcast.* This is plainly apparent in the patent drawing (Vol. 4, p. 2136) and is described in the specification (p. 2138, lines 8-24), and was specifically stated in the reports and by the witnesses. Mr. Chapman said:

“The first agitation was of a very violent type to bring about the oiling of the sulphide mineral. *The agitated pulp was then passed to a small glass upcast where the fine gangue slimes were washed from the pulp, allowing only the oiled metalliferous particles and the coarse gangue [which sank in the upcast] to pass to the second stage of the process, which consisted of slowly rolling in the same type of mixer as used in the first stage but with the baffles taken out and the speed of the cones much reduced*” (pp. 238, 239).

The evidence also shows that in the final Cattermole experiments, made in the London laboratory while Mr. Chapman was in Australia installing the Cattermole process, it was found advantageous to do away with two-stage agitation, and to follow a single stage prolonged agitation by a single separation of sinking gran-

ules in an upcast (Sulman & Picard Report of Feb. 21, 1905, Vol. 2, pp. 1088, 1089, par. 5). This was, however, never tried in practice and the Cattermole process failed in the mill and was abandoned before the knowledge of the invention in suit reached Australia and saved the venture.

An interesting experiment contrasting the process in suit and the Cattermole process was shown by Mr. Higgins at the trial. In a Gabbett, at between 850 and 900 revolutions per minute, with appellant's ore and two pounds of oleic acid to the ton of ore, .1%, Mr. Higgins produced an excellent mineral froth (Vol. 8, pp. 4747, 4748, Qs84-86). Then he added 3.6%, 72 pounds to the ton of ore, of oleic acid, making a total of 3.7%, or 74 pounds to the ton (Q93) repeated the same agitation, and the froth was wholly destroyed and granules formed (Qs94-96). To show that high speed was not injurious Mr. Higgins then ran the machine at over 1500 revolutions per minute, but the result was just the same as at the lower speed. Excellent granules were removed from the bottom of the vessel which had taken up practically the whole of the metalliferous mineral (Q100).

Cattermole patent No. 763,259 (printed Vol. 3, pp. 1246-1249). This patent is mentioned by appellant's expert Dr. Sadtler as stating the advantage of fine pulverization in the Cattermole process (Vol. 5, p. 2788). The ability to treat slimes and the fact that the best results were obtained with fine grinding, were undoubtedly great advantages of the Cattermole process. As Mr. Higgins says the Cattermole process was "the first

process to successfully concentrate slime material” (Vol. 8, p. 4521, XQ290). It was characteristic of that process that

“the finer the ore the more compact and cohesive are the granules formed from it” (Vol. 3, p. 1247, Spec. p. 1, lines 90-92),

as quoted by Dr. Sadtler in his testimony above referred to.

This patent happens to be the lowest numbered and one of the two earliest issued of the Cattermole series. It does not disclose a process of concentrating ores. It discloses a process for breaking down or disintegrating the sunken granules produced in the Cattermole ore-concentrating process, so as to obtain as separate products the sulphides of the different metals. It specifically refers to “Broken Hill ore” (Spec., p. 2, line 74) as the specific example of the ore the granules produced from which are to be thus treated.

Cattermole patent No. 763,260 (printed Vol. 3, pp. 1250-1253). This patent like that last referred to, was put in evidence by the complainants in the Hyde suit. It was issued June 21, 1904, on an application divided out from the application on which patent No. 777,273 issued, and covers the modification of the Cattermole process wherein the circuit is alkaline. In patent No. 777,273 there are broad claims (1 and 2) not limited to acidity or alkalinity. The remaining claims are specific to the presence of an acid. In this divisional case the claims are all limited to the presence of an alkaline emulsifying agent. In other respects the disclosure is the same as in patent No. 777,273, and like

that patent it specifically cautions the user that a lean ore must be enriched (Spec., p. 3, lines 26-35).

SULMAN & PICARD PATENT NO. 793,808.

This patent issued July 4, 1905 (printed Vol. 4, pp. 2146-2150), after the birth of the invention here in issue, but on application filed October 5, 1903, when there was some hope of making something out of this skin flotation process. In the Hyde suit Dr. Byrnes misrepresented it as a froth producing process, testifying that he had reproduced the apparatus of Figure 1 of this patent, had used the revolving worm to produce a vigorous agitation, and had obtained a thick and satisfactory froth (Vol. 4, p. 1527). His apparatus was put in evidence and delivered to complainants, and they were unable to obtain these results and with repeated tests only produced skin flotation (Vol. 2, pp. 585-588) and Dr. Byrnes' evidence was further criticized (pp. 589-594).

At the present trial there was in behalf of appellant only a feeble reference to this patent as disclosing the use of gas bubbles for the purpose of floating metaliferous mineral particles to the surface of a pulp (Sadtler, Vol. 5, p. 2785). This is in fact disclosed under conditions both as to the oil proportions described (from moistening the particles up to a maximum less than oil-buoyancy flotation) and general conditions of procedure such as inhibit froth formation. The air or gas bubbles, according to this process, escort

the metalliferous mineral particles to the surface and leave them there.

Mr. Higgins briefly refers to this testimony of Dr. Sadtler (Vol. 8, p. 4594, Q374). He says that in this process, where gaseous bubbles are used, they carry the mineral to the surface and burst, and the mineral either sinks or floats, like the greased needle, by skin flotation. He further says that there is in this patent no disclosure of any froth whatever. He further says that the specification also discloses flotation without the employment of any gaseous bubbles, and refers to the three variations of apparatus shown in the drawings, each of which produces skin flotation (*idem*).

It may be noted generally that the patent discloses three general methods (1) flotation of oil-moistened particles where the oil is "insufficient to raise the oiled mineral by virtue of the flotation power of the oil alone" (Vol. 4, p. 2149; Spec., p. 1, lines 25-28) without any description of apparatus; (2) flotation carried on in the apparatus of Fig. 1 wherein the mineral is oiled by carrying atomized or vaporized oil with air or gas into the pulp through perforations in a revolving worm; (3) flotation by spraying or throwing the oiled mineral upon the surface of water, carried on in the two varieties of apparatus shown in Figs. 2 and 3.

Although little was heard of this patent in the Hyde case after exposure of the erroneous testimony of Dr. Byrnes, it was relied upon in the Miami case, and Judge Bradford fully considers it and says that it "affords cogent circumstantial evidence of the patentability of the process of the first patent in suit" (the patent here

in suit) (237 Fed., 628). The Circuit Court of Appeals of the Third Circuit also refers to this patent (Opinion, p. 6; pp. 26, 27), and dismisses it either as an anticipation or as justifying the use by defendant of the Callow cell.

KIRBY PATENTS.

There are two Kirby patents. The process patent No. 809,959 issued January 16, 1906 (printed Vol. 4, pp. 2158-2166), on an application filed December 14, 1903, and the apparatus patent No. 838,626 issued December 18, 1906, on an application filed December 17, 1903 (printed Vol. 4, pp. 2176-2180). Although these patents, and particularly the process patent, were fully considered in the Hyde case and prominently presented by the defendant there in the arguments before this court and the Supreme Court of the United States, and were disposed of as anticipations by the Supreme Court of the United States, the appellant here has again presented them with an elaborateness far beyond any possible value that can be attached to them. It is to be noted, however, that the Kirby patents are not specifically referred to in appellant's brief. The general references to "prior-art quantities of oil" and "prior-art froths" (p. 29) are undoubtedly intended to refer to Kirby. But Kirby is not named.

The evidence at the trial of the case at bar for the first time exposed the character of the spurious experiments alleged to represent this process made on behalf of the defendants at the argument before this court, the

Supreme Court of the United States, the District Court at Wilmington, and the Circuit Court of Appeals at Philadelphia.

The secret of the success of these operations, which plaintiffs could not then duplicate, was the presence of a soluble frothing agent contaminating the kerosene oil. At the present trial Mr. Phillips performed an experiment with 25% of alleged kerosene oil in a small square glass jar (Vol. 6, p. 2920; pp. 2922, 2923) with an agitator known as a bar mixer. Floating material carrying a fair amount of mineral was produced, and this was called a froth and was said to be a reproduction of the experiments shown in Phillips' photographs 18-1, 18-2 and 18-3 (Vol. 9, pp. 5116-5118). At the request of appellees' counsel this machine was delivered to appellees' experts with specimens of the materials used. The speed of agitation was found to be between 9,000 and 10,000 revolutions per minute (Higgins, Vol. 8, p. 4604, Qs410, 411) with a very small agitator, giving a peripheral speed of about 1,800 peripheral feet per minute (Q412). The experiment was repeated by Mr. Higgins with these materials and he got the same result as Mr. Phillips (p. 4617, Qs481, 482), but on attempting to repeat it with kerosene other than that obtained from Mr. Phillips the experiment was a failure (Q484). This was thoroughly tested with kerosene from eight different sources with the same result. Mr. Higgins then found that none of these kerosenes contained any soluble frothing agent and that Mr. Phillips' kerosene specimen did contain a soluble frothing agent which gave indications of being the soluble part of pine oil (*idem*; p. 4612,

Q449). This was also true of a larger specimen of kerosene obtained from the appellant (Q450). Mr. Higgins then repeated the Phillips experiment in court with ordinary commercial kerosene, and wholly failed to obtain the result exhibited and photographed by Mr. Phillips, the results being metallurgically useless, with the bulk of the oil and the bulk of the mineral at the bottom of the vessel (Qs487-490).

Dr. McIlhiney also examined these specimens of kerosene, and additionally the specimen supplied by Mr. Dosenbach as that used in his experiment with 25% of kerosene said to represent the Kirby patent, and he found a soluble frothing agent in each of them, rather indeterminate in character, but suggesting pine oil or wood product (R., pp. 2695, 2696, Qs62-67).

Mr. Higgins verified this after having failed to produce any metallurgical result with the use of ordinary kerosene, by further adding to the pulp in the machine a minute amount of pine oil in the proportion of one-tenth of one per cent. and reagitating, and thereby reproduced the result that Mr. Phillips had produced, exhibited and photographed (p. 4620, Qs490-492).

By way of suggestion of the possibility of such a contamination as was found in this kerosene oil Mr. Dosenbach had previously testified that at the Butte & Superior plant they used their storage tanks successively for different oils without cleaning them out in the interim (Vol. 7, pp. 3890, 3891, XQs149-151) and of course it was only necessary to put the kerosene in a tank that had formerly contained pine oil, and nature did the rest. Possibly also careful examination and selection from

hundreds or thousands of specimens of kerosene oil may result in the discovery of a specimen of kerosene oil contaminated with a soluble frothing agent, and therefore capable of producing what Messrs. Phillips and Dosenbach produced and exhibited to the court, which was in fact a floating aerated paste, the oil in the paste carrying the mineral, and the air bubbles inflating and lightening the paste like the pores of a sponge but not attached to the metal, because air bubbles in oil will not attach metal to itself however finely ground the metal may be.

Following this exposure Dr. Sadtler testified to elaborate investigations of the kerosene used in appellant's experiments, in place of the simple experiment of dissolving out the soluble frothing agent with water, and as a result of his elaborations obtained a separated portion which gave a slight woody odor (pp. 4785-4790), thereby confirming Mr. Higgins' and Dr. McIlhiney's determinations.

It is therefore a proved fact in the case that kerosene oil will not produce a froth even under conditions of terrific agitation which Kirby never dreamed of, and that Kirby's minimum proportion of 25% of oil, or 500 lbs. to the ton of ore, even under conditions of terrific agitation, will not produce an inflated paste or magma carrying part of the metalliferous mineral, unless the kerosene is contaminated with a soluble frothing agent.

But these experiments had nothing to do with Kirby's actual disclosure. Kirby shows and describes an elaborate apparatus, and this appellees constructed in exact accordance with Kirby's drawings (Higgins, Vol. 8, pp.

4494, 4495, Qs150-152). In that apparatus Mr. Higgins carried out the Kirby process with the Kirby ore, ore from the Rossland mine (Qs154-156), using the oil mixture of Kirby's example said to give the exact adhesive preference for that ore, this mixture being 95% of kerosene with 5% of semi-solid petroleum residuum (Q157), and using Kirby's minimum proportion of 25% of oil (Qs158, 159). This ore was crushed to 80 mesh, although undoubtedly Kirby used coarser crushing (p. 4503, Qs195, 196), but the finer crushing helped flotation. Acid was used because it improves the result and is suggested by Kirby (Qs201-204). Streams of oil and streams of air were flowed into the separating tank through the slowly moving agitator as described by Kirby (Qs206-208). The agitator in the mixing tank was rotated at a speed of 188 revolutions per minute (Q209) and in the separating tank at a speed of 30 revolutions per minute (Q210). Baffles were provided in the mixing tank, although not described by Kirby, because otherwise water would overflow from the vessel during mixing (Qs211-213). The result of the operation was a thin layer of oil with mineral carried chiefly in the lower part of this layer and in fact at the oil-water interface, as described by Kirby (R., p. 4507, Q215). A peculiar phenomenon, described by Mr. Higgins as a crumpled up oil-water interface, resulted from the weight of the metalliferous particles and the disturbance caused by the passage of air through the pulp. This result was exhibited by pouring the overflow into a bottle, and it was seen that there was no mineral in the oil except at the interface (p. 4509, Q224 et seq.).

This was the Kirby result, not in any degree resembling a froth.

It is of interest that the experiment producing a crumpled up oil and water interface was first performed by Professor Beach, demonstrating the greatly increased viscosity at such an interface and that the presence of mineral particles at that interface added to that viscosity (Vol. 6, pp. 3060-3063, Qs29-35), and Mr. Higgins referred to that experiment (Vol. 8, p. 510, Qs232, 233). This scientific fact, demonstrated and confirmed by appellant's scientific experts, explains the possibility of carrying on the Kirby process with a thin oil. With Elmore's thick oil the viscosity of the oil holds the metal within the oil layer, although it tends to settle therein. But with Kirby's thin oil nothing but the increased viscosity of the interface prevents the metal from sinking to the bottom of the pulp, and the presence of metal there adds to the viscosity of the interface. As Kirby says in his specification:

"The floating concentrates are carried mainly at the lower surface of the hydrocarbon layer, where it is in contact with the water" (Vol. 3, p. 2163; Spec., p. 3, lines 55-58),

and the fact appears to be that all of the metal that Kirby succeeds in floating off is carried substantially at this oil-water interface. The recovery was not encouraging, being 36.4% (Vol. 9, p. 5562), but the process was a failure anyway, and the reason for this is quite obvious.

Mr. Higgins explains the Kirby patents in connection with the experiment above referred to (Vol. 8, p. 4492, et seq.).

Plaintiff's reproduction of the Kirby apparatus was made after the argument in this court of the Hyde case. The Kirby ore was not available or used in the Hyde case. A full understanding of the Kirby phenomena was not attained in the Hyde case. The secret cause of the production of an aerated oily magma by terrific agitation with 25% of oil was wholly unknown to the appellees when appellant's experimenters for the first time exhibited to the appellees at the argument in this court the experiment alleged to represent the Kirby disclosure. Indeed, the fact that such a result could be produced was unknown to them. In the Hyde case there was no trial in open court. Dr. Byrnes had testified that he had obtained a froth with 25% of oil (Vol. 4, pp. 1523, 1524), but appellees' experts were unable to reproduce it (Vol. 2, pp. 622, 624). Its production in this court was a complete surprise to the appellees and the mystery was not solved until the trial in open court of the present suit.

The reproduced Kirby apparatus, with the Kirby ore, was first used in evidence in the trial of the Miami case. At the argument of the Hyde case in the Supreme Court, upon the statement by plaintiff's counsel as to the condition of the record, and with the consent of the Justices to showing an experiment not described in the record, the Kirby demonstration of the Miami suit was repeated in the Kirby apparatus, with the Kirby ore.

CALIFORNIA JOURNAL OF TECHNOLOGY.

The article first gives a brief outline of the Elmore process "as it is in actual operation" (p. 5036).

An illustration is given of a large scale Elmore plant containing three agitating vessels and separating vessels (p. 5036), and this is described, and it is said that

“usually about a ton of oil is kept in operation for each ton of ore, but the losses of oil are small, the recovered oil being used over and over again” (p. 5039).

The oil described is “a heavy residuum of consistency of ordinary cylinder oil” (p. 5038). This is the Elmore oil, petroleum residuum, an inert oil in the process in suit, not a frothing oil (Higgins, Vol. 8, pp. 4740, 4741, Q54). The method of recovering this oil from the concentrates by centrifugal separation is then described.

This is followed by a description entitled “Laboratory Methods” and here we have the first reference to the use of an agitation more violent, and an amount of oil much smaller, than that which characterizes the Elmore process. It is said

“the charge may be agitated very gently, the oil being kept in a single lake and broken up as little as possible, consistent with a thorough contact of pulp and oil; or the charge may be agitated so violently as to dash *the oil* up into a foam or *froth full of air bubbles*” (p. 5040).

This latter was the new contribution of the students resulting in the production of a floating mass of oil full of air bubbles—an air-distended or spongy magma.

Later, under the same heading, this method of more violent agitation is again described as accomplished

“by violently shaking the tube, thus producing the foam effect, or at least shattering *the oil into small globules*” (p. 5041).

Then follows a description of the floating off of the oil carrying the concentrate, the mineral laden oil, and this is applied as to three methods of agitation, the first and second being the gentle agitation of Elmore producing mineral laden oil without bubbles in it, or as the students well name it, the "lake effect," and the third being the violent agitation or what they call the "foam effect." Further it is said as to the product of all three methods of agitation:

"The *mineral laden oil* is then heated and treated in the cylindrical separator as above described" (p. 4042).

Thus, without any question, whether the agitation is gentle or violent and the result the "lake effect," or "the foam effect," *mineral laden oil* is treated in the cylindrical separator or centrifugal to recover as much oil as possible; and also, as is stated in the preceding description, the recovered oil is used over and over again" (p. 5039).

The advantages of an acid solution are then stated as (1) chemical action in dissolving oxide coatings, (2) increasing the specific gravity of the solution and thereby adding to the buoyant effect of the oil, and (3) particularly aiding the "foam effect" by generating gases, it being stated the "foam effect" is

"due to the generation of certain gases" (p. 5042).

This latter is not further explained, but all these advantages suggest the use of a very considerable amount of acid. No details are given, however, of any definite experiments with definite amounts of acid, or of the

production of the "foam effect" by the use of acid or acidified water.

The advantage of the salt solution is then described, that by increasing the specific gravity of the water it multiplies the difference in gravity between the water and oil by three, thus giving the oil

"a carrying capacity * * * threefold greater than with water alone" (p. 5042).

It is also said that the salt solution aids in producing the "foam effect," which they probably ascribed to its inherent tendency to foam (although it is not a mineral frothing agent) (Higgins, Vol. 8, p. 4524, Qs302, 303).

Then comes the heading "Tests—Molybdenite Ore" (p. 5044). Here it is stated that the ore was of low grade with values fairly well disseminated and that the samples were crushed to 20, 30 and 40 mesh and treated in percolating tubes. Percolating tubes are glass laboratory test tubes with stoppered bottom openings for draining their contents. Then follows a table giving details and results.

Experiment No. 1 is an Elmore experiment with 2,400 grammes of oil to 2,000 grammes of ore. The ore was crushed to 20 mesh, there were four treatments (the oil was extracted and used over again three times) and the recovery 6.3% was ridiculous. The text following says that this shows that the oil required

"finer crushing to liberate the sulphide" (p. 5042).

Finer crushing was therefore resorted to, and experiment No. 2 was made with a sample crushed to 30 mesh. Here the recovery was much better, 67.6%.

Then experiment No. 3 was with the finest crushing, 40 mesh, and here the recovery was about the same, but the grade of concentrate fell off to the lowest in all of the experiments 17.4% of molybdenum sulphide. The comment on this is:

“That although the finer crushing has freed the MoS_2 from the gangue, at the same time it has produced a larger percentage of fine gangue which, becoming mechanically occluded in the oil, gives a low grade concentrate” (p. 5044).

Thus these students rediscovered the well known fact that the Elmore process cannot treat slimes, and that 40 mesh crushing was too fine (it contained too much slime) and so they went back to 30 mesh and all of the other experiments in this table were with ore crushed to 30 mesh.

Experiment No. 4 is the first “foam effect” experiment, and in it they boldly cut down the oil percentage to 2.1%. Evidently they did not succeed in extracting enough oil for repeating the operation, as there was but one treatment, although their concentrate contained 75% of oil which would make a very good thin paste or magma (Higgins, Vol. 8, p. 4522, Q293; p. 4524, Q301). The grade of concentrate was poor, 32.4% of molybdenum sulphide, and the recovery was hopeless, 43.5%. The experiments were made “in a salt solution” (p. 5045) and they therefore had the assistance of increase of oil buoyancy and of the natural tendency

of salt water to foam. What they obtained in this and the other foam experiments they describe later as follows:

“This throws *the oil* into a froth, which is heavily charged with air or other gases. This gas, of course, gives a greatly increased buoyant force” (p. 5052).

In experiment No. 5 they more than doubled the amount of oil, using 5.3%, and here there were two treatments, as would be expected with the increased amount of oil. The recovery was only 47% and the grade the same, and thus the improvement was slight from experiment No. 2, but it was some improvement and therefore in experiment No. 6 they nearly doubled the oil, using 8.9% and three treatments, and secured a recovery of 75%. This is the only experiment upon which they favorably comment. They say:

“In experiment No. 6 only about ten cc. of oil was used for one hundred grammes of ore. This gave an extraction of 75%, with concentrates running 32.4% MoS_2 ” (p. 5045).

But although the recovery was possibly a reasonable recovery, it is truthfully said that the concentrates were not marketable, and therefore they were reconcentrated, and in these reconcentration tests (7, 8 and 9 of the table) we have the only reference to the use of sulphuric acid, and it was evidently here used without further addition of oil in an agitation lasting fifteen minutes to cut out the gangue from the heavily oiled concentrate, and then followed by the addition of a further quantity of oil, apparently the 3% of the table, and a further agitation to float a concentrate of higher grade.

The remainder of the article deals with the Elmore lake effect, and much is said about tests of copper ores and gold ores, and it is very evident that if they had found that the "foam effect," with its economy of oil, only 10cc. of oil for 100 grammes of ore, 8.9%, 178 lbs. of oil to the ton of ore, instead of 2,000 lbs. of oil to the ton of ore, could have been successfully used for copper or gold ores, the article would have described it. The conclusion moreover expresses the views of the students as to what they had discovered. They say:

"The foam effect is best adapted for light, flaky minerals, such as molybdenite" (p. 5052).

Again they say that what happens is that the agitation

"throws the *oil* into a froth, which is heavily charged with air or other gases. This gas, of course, gives a greatly increased buoyant force. The *oil* in this condition assumes a certain load of mineral and holds it in a very stable condition" (p. 5052).

These interesting experiments did not add anything to the knowledge of the art that was of the slightest value towards the discovery of the process in suit. In fact they point away from it. The procedure which they carried on at 2.1% of oil was a failure, at 5.3% of oil was but slightly improved and also a failure, and at 8.9% of oil was alone worthy of consideration by metallurgists. The further investigations which their experiments suggest may be summed up as follows: (1) the use of oil at 8.9% and the avoidance of smaller proportions of oil; (2) the use of the Elmore oil, which is not a frothing oil and is inert in the process in suit;

(3) the use of salt solutions to increase, in fact multiply by three, the buoyancy of the oil; (4) crushing only to 30 mesh and the avoidance of slimes; (5) limitation of the foam effect to light, flaky metallic minerals such as molybdenite as contrasted with copper and gold. This leads far away from the invention in suit.

Mr. Higgins' testimony as to this publication explains the principal points above stated (Vol. 8, pp. 4521-4526, Qs291-313; pp. 4740, 4741, Q54). He says in part:

“These experiments show in the first place such low extraction and such low values in concentrates that they are utterly worthless as metallurgical operations” (Vol. 8, p. 4522, Q292).

Mr. Higgins also says as to the three “foam effect” experiments 4, 5 and 6 of the table:

“Q301. What is your understanding of what happens in these operations, experiments 4, 5 and 6?

A. Well with that quantity of oil to that quantity of concentrate there was a minimum of 75% of oil. That would make quite a nice thin paste, which has been described as a magma, and that magma would become distended with air bubbles introduced during agitation, and what we would have in the percolating tube would be the flotation of a magma distended with air bubbles” (Vol. 8, p. 4524).

Magma. The term “magma”, which Froment so aptly uses to describe his float, is the appropriate descriptive word for the character of float produced both by the Froment patents and by the California Journal of Technology in its so-called “foam effect”. The students describe their float as mineral-laden oil heavily charged with air or other gases, and say that it is the oil in the float which carries the mineral—“assumes a certain load

of minerals and holds it in a very stable condition," etc. A magma is a paste, and the kind of magma produced in these operations is an inflated paste carrying metallic particles. It is like a cork lightened by the pores in it so that it has greater buoyancy. It is like a mass of soap made spongy by air bubbles, such as the ordinary floating soap of commerce and such as described in the Hyde Record under the heading "Flotant Soaps" (Vol. 4, p. 1821). Specks of metal distributed through such a soap would correspond to the metallic particles in a mineral-laden magma. In such a magma the metallic particles would be distributed through the viscous oily mass and not attached to the air bubbles at all, for air in oil has no attraction for metallic particles—an air bubble in oil will not pick up even the most minute particle of metallic dust (Vol. 8, pp. 4566, 4568; pp. 4225-4229, Qs44-47). The only function of an air bubble in a floating magma is to lighten the mass of oil and add to its buoyancy, so that a much smaller amount of oil than Elmore required will nevertheless float a fair amount of metal. Such a float resembles a mineral froth in external appearance, and in a small glass vessel it looks quite like a froth, but it is essentially different in structure and is useless in metallurgy. It never got beyond the Froment laboratory test tube or the California students' laboratory percolating tubes.

The Supreme Court of the United States dismissed the Froment process as "little more than a laboratory experiment" (Opinion, p. 4) and would certainly have dismissed this disclosure as *nothing more than a laboratory experiment*, had it been before them.

Appellant in only one instance repeated an experiment resembling that described by the students, with 5.3% of the students oil, a heavy petroleum, non-frothing. This experiment, with saturated salt solution (Vol. 5, p. 326 et seq.), appeared to produce what the students described, a floating mass of oil carrying metal-liferous particles and heavily charged with air, in other words a magma. What the recovery was no one knows, but if it was as good as the students obtained, 53% of the metal was in the tailings. Appellant should have followed the instructions of the students and increased the amount of oil to 8.9%, 178 pounds to the ton of ore.

The other experiments of appellant alleged to show what these students had disclosed, clearly failed to do so. The other test-tube experiment with sulphuric acid and water heated to 40° Centigrade (104° Fahr.) was clearly unjustified. Sulphuric acid is not described as used in primary separation, but only for washing the gangue out of the concentrates, and whether it is present or not in the final reconcentration does not clearly appear. However this may be, heating was clearly unjustified. The students were dealing primarily with the Elmore process, where heating thinned the oil and caused it to drop the metal, and there is not the faintest suggestion of the discovery made known in the patent in suit, that heat assists in the formation of a mineral froth. The advantage of heat in mineral froth formation is admitted by Professor Taggart (Vol. 6, p. 2967, Q49). The students avoided heat in their work of concentration because Elmore taught them to avoid it. They only used it after the concentration was com-

pleted and the concentrate separated from the gangue, to assist in separating the oil from the concentrate; and in such use of heat the heating of the oil is properly said

“to thin it and overcome its viscosity” (p. 5038).

Appellant's Model Pyramid Machine. These criticisms apply to all of these experiments, except that carried on in defendant's exhibit 226, model pyramid machine, and those experiments carried on in the modern Janney machines on a large scale and said to represent, indifferently, Everson, Froment, Kirby and the California Journal of Technology. The latter will be considered later. The model machine experiment was carried on with 2.1% of oil and was therefore prominently put forward as a repetition of what the students did.

It is only necessary, however, to consider the oil constituent to dismiss this experiment as in no way related to what the California students did. Appellant used its wonderful oil mixture (the product of years of study and research for means to evade the patent in suit), consisting of 70% of the students' oil, fuel oil or petroleum residuum, 12% of kerosene to thin this oil and thus impair its utility in the students' experiments, and 18% of pine oil, an essential oil, partly insoluble active frothing agent and partly soluble active frothing agent. Pine oil was therefore present in the proportion of .378% of the ore, part oily frothing agent and part soluble frothing agent. The other oils, fuel oil and kerosene, were inert. The only oily frothing agent present was the insoluble part of the pine oil.

This was present in critical proportions amounting to a small fraction of one per cent. of the ore. The presence of the soluble frothing agent made it possible to dump the inert oils into the pulp, 1.47% of fuel oil on the ore and .254% of kerosene, without spoiling the air-froth flotation process, and therefore the process of the patent in suit and the process of the solution patent (soluble frothing agent patent No. 962,678) could be carried on conjointly with impaired but not impossible results.

The procedure resembled that carried on in appellant's mill. The same ore was used with its abnormally large oil-absorbing clay gangue constituent. Cold water was used to solidify the grease constituent. The agitation, although not that of a Janney machine, was abnormally intense, with a speed of 1988 revolutions per minute and a peripheral speed of 1561 peripheral feet per minute (Dosenbach, Vol. 8, p. 3904, XQ188).

Mr. Higgins briefly states the reasons above given for his conclusion that the process was not that disclosed by the California students and was a joint use of the process of the patent in suit and of the solution patent, impaired but not destroyed by excess oil (Vol. 9, p. 4780, RDQs240, 241; pp. 4773, 4774, XQs198-207).

Judge Bradford gave careful consideration to the disclosures of the California Journal (237 Fed. 623). The Third Circuit Court of Appeals merely dismissed it as an example of the use of air

“to supplement the natural buoyancy of oil and to assist the oil-coated particles to the surface” (Opinion, p. 6).

Judge Bourquin below says:

“The only new publication is the California Journal of Technology detailing a suggestive but rather misleading and abandoned experiment, sufficiently referred to and disposed of in the Miami suit” (Vol. 1, p. clxxxiv).

APPELLANT'S LARGE SCALE OPERATIONS OF NO PROBATIVE FORCE FOR ANTICIPATION.

All of the deceptive laboratory experiments misrepresenting the prior art made in behalf of the defendant in the Hyde suit having failed to convince the Supreme Court of the United States, and similar experiments in the Miami suit having similarly failed in the District Court of Delaware and the Third Circuit Court of Appeals, the present appellant has resorted to new tactics and we now have large scale operations and experiments carried on in the modern Janney machine in the light of all knowledge which the process in suit has given to the world and with agitation of an intensity far exceeding even appellees' procedure, and these operations and experiments were put forward in the evidence as representing, indifferently, Everson, Froment, Kirby and the California Journal of Technology.

The allied companies appear to have actually operated small portions of their plants over a period of some months with a definite and persistent effort to use twenty pounds or more of oil to the ton of ore. The remarkable fact about these operations is that they approach so close to this artificial border line—indeed, many of them fail to overstep it. It is a patent fact that, however much may be at stake, no mill will carry

on the flotation process in regular operations with an oil proportion exceeding one per cent. by any but a very small fraction of one per cent. and that in many instances these operations cannot be carried on at all, notwithstanding the presence of inert oils, with oil proportions exceeding one per cent. This is notably true as to the slimes flotation plants at the Utah, both mills, Chino and Ray, of many times the capacity of the small retreatment plants in which efforts were made to maintain daily operations with twenty pounds or more of oil.

Another remarkable feature about all of these operations, whether regular operations or brief experiments, is that in every instance a soluble frothing agent is present, dissolved in the pulp, whether included in the oil feed or dissolved in the circuit water from former operations. It is the presence of a soluble frothing agent which permits wasteful use of an inert oil without destroying froth flotation.

The genesis of these operations is obviously not to be found in the prior art. Even Dr. Sadtler admits that they were made with improvements and knowledge and experience which followed the introduction of the process in suit into this country, as follows:

“XQ589. With improvements and knowledge and experience which have followed the introduction into this country of the process of the patent in suit. Isn't that right?

A. Yes; there has been an immense mass of experimental work done in all the mills, which contribute to it” (Vol. 7, pp. 3791-3792).

The genesis of these operations is to be found in the patent in suit, but the further knowledge given to the

world by the soluble frothing agents patent No. 962,678 on June 28, 1910, was necessary to the carrying on of these operations, since they all involve the use of soluble frothing agents.

It is interesting that even Mr. Dosenbach does not ascribe his knowledge of the possibility of using larger quantities of oil in air-froth flotation to the prior art, but ascribes it to the fact that in the Summer of 1913, in testing the process of the patent in suit for infringing operations at the Utah Copper Company, he stumbled accidentally upon the fact that with certain coal tars and coal tar derivatives it was necessary to use large quantities to obtain flotation results (Vol. 6, p. 3397, XQs361-364). Coal tar contains tar and oil and the soluble frothing agent phenol. The oil and the phenol are excellent mineral frothing agents. To this it was only necessary to add the knowledge that heavy petroleumums can, under carefully studied conditions, be mixed with coal tars or phenols so as not to destroy mineral froth formation, and that a sufficiently impure coal tar may sometimes be used alone, and we have the explanation of every large scale mill operation, regular or experimental, proved in behalf of the appellant wherein one per cent. or more of a material called oil is used.

The use of tar, grease and waxy substances is exceedingly convenient when the object is to increase the amount of useless material used under the name of oil. Examples of this are the use of a solid mineral wax Gilsonite, which looks like asphaltum, and contains only 56% of oil, as testified to by Mr. Thomas A. Janney (Vol. 5, pages 2606-2607, XQs310-315), and the presence

in the appellant's and other heavy oil mixtures of grease which becomes semi-solid in the cold water used.

A consideration of the details of the many oil-wasting operations testified to in behalf of the appellant is deemed here unnecessary. In so far as they were the actual operations of the appellant they have been considered under the heading of "Infringement". The operations of the other infringers so far as proved have been considered under their respective sub-headings under the general heading "Commercial Use of the Invention—Infringers". In only one instance were these operations other than those of appellant performed in the presence of appellees' representatives, and that operation will now be considered.

Utah Copper Co.—Magna Plant—Oil-Wasting Experiment. During the trial, on April 22, 1917, an operation was performed in the presence of appellees' representatives wherein 21.8 pounds of oil (1.09%) were used per ton of material treated.

This operation is described by Professor Fulton and Messrs. Chapman and Greninger, appellees' representatives.

There were seventeen Janney machines in series and in each machine an agitating compartment and two spitzkastens on opposite sides of the agitating compartment. From the spitzkastens floating material was discharged, while the tailings, deprived of the material which overflowed from the spitzkastens passed on to the next machine (see flow sheet, Plaintiff's Exhibit 245, Vol. 9, p. 5347). As Mr. Conrads, metallurgical engineer of this plant admitted, the result was that

each spitzkasten removed a large amount of oil and the oil proportion was stepped down from machine to machine (Vol. 5, pp. 2709, 2714, XQs381, 415).

The double spitzkastens of each machine were practically duplicates, each receiving half of the agitated product of the admittedly "terrific agitation" (Conrads, Vol. 5, p. 2709, XQ387) in the agitating compartment of the machine. The seventeen spitzkastens arranged in a row at one side of the machines may therefore be taken as representative of the other seventeen spitzkastens on the opposite sides of the machines, and this was done in the work of sampling, which was confined to one of the rows of spitzkastens.

In the exhibited operation the first spitzkasten was used as an oil collector and remover and thereafter the process proceeded without a troublesome excess of oil. The float in this first spitzkasten contained about 412.31 pounds of oil per ton of ore (Deft's Ex. 251, Vol. 9, p. 5358) ((524.80 lbs. per ton of ore)), 25.97% according to appellant's analyses and 26.24% according to appellees' analyses (Vol. 8, p. 4686 Qs29-30). This float, as described by Professor Fulton, was mechanically divided on a plaque into (1) a floating oily emulsion carrying traces of mineral, (2) oil-air bubbles carrying a little mineral, and (3) the ordinary agitation froth, but in small amounts (Vol. 8, p. 4405, Qs19-20). Mr. Chapman analyzed it on the plaque as containing (1) a collection of oil globules badly broken up with air, (2) a sunken oily slime, (3) oil globules easily separable from the settled slime, and this slime was like the sunken concentrate which could be vanned from the

result of the agitation froth process (p. 4427, Q6). Mr. Greninger says that it separated into two distinct products, one being an oily emulsion containing oil globules and little mineral, and the other the mineral froth (p. 4334, Q50). Mr. Chapman says that this first spitzkasten was really used for oil concentration (p. 4426). This oily float overflowed only at intervals, evidently to give the impression that the spitzkasten was out of use. Beyond this in the second and succeeding spitzkastens an air-froth carrying abundant mineral was discharged, and without question in 16 of the 17 machines the process of the patent in suit was being carried on in the presence of an amount of oil much less than 1% of the ore.

Professor Fulton's description of these operations (pp. 4403-4407), further added to on cross-examination (p. 4415, XQ62; p. 4420, XQ90). Mr. Chapman's description (pp. 4424-4430; pp. 4447, 4448, Qs81-86), also further added to on cross-examination (pp. 4449, 4450), and Mr. Greninger's description of these operations (pp. 4332-4342), which was also added to on cross-examination (pp. 4344-4348) are quite full and complete. Mr. Chapman testified as follows:

"Q81. Having before you all of these determinations, and having seen the plant in operation, I wish you would say what process was being carried on at the Utah Copper Company on the occasion of your visit.

"A. The process employed at the time of our visit was undoubtedly that of the agitation froth process. The incident of that oil removal at the first spitzbox, not being one of ore concentration, I would exclude that one box; but the rest of the plant was undoubtedly the agitation froth process" pp. 4447, 4448).

Mr. Greninger testified that he considered the process which he there saw substantially the same as the standard Minerals Separation process with which he was familiar (p. 4340, Qs83, 84).

The grease chilling phenomenon of the Butte & Superior process was here repeated, and a substance known as Calura was used in large quantities and undoubtedly assisted in preventing destruction of the process by the excess of oil.

It is impossible to consider this operation as representative of anything in the art prior to the process in suit. It merely shows what the ingenuity of an infringer may do when he wishes to use the process in suit and tries to mask it.

MOVING PICTURES.

These pictures were prepared and exhibited by Dr. William Mason Grosvenor, and the films are in evidence as Plaintiff's Exhibit 227. He testifies as to the care which he took to assure that the experiments represented were veritable experiments by testing them over and over again, and were accurately portrayed in the pictures (Vol. 8, pp. 4706-4707, Qs1, 2).

The explanation of these pictures (Vol. 8, pp. 4538-4591) is full and complete. Briefly they show phenomena of actual occurrence and capable of this kind of picturing, which to some extent exhibit the operation of the forces at work in air-froth flotation, and they conclude with pictures actually showing the interior structures of an air-froth and an oil-froth or magma.

“1. The strong attachment of unoiled or deoiled mineral particles for air bubbles. Four sizes—Galena—6 milligrams, 15 milligrams, 20 milligrams, 40 milligrams” (p. 4538).

Clean air bubbles immersed in pure water and held down by inverted cup shaped bubble holders are applied to these particles and the strength or weakness of attachment of the particles and these captive bubbles is exhibited by manipulation. All except the heaviest (40 mg.) particle have been oiled and then deoiled, under water, by prolonged bubbling of air, to a film comparable with the adsorption film.

The 6 mg. particle is the heaviest galena particle which can be lifted by a captive air bubble gently manipulated and coated with oil to Cattermole proportions (8% on mineral). Particles thus coated will stick together by reason of their oil coatings—may be agglomerated into granules. This particle is seen to be instantly lifted. A very vigorous jerk is necessary to detach it from the bubble.

The 15 mg. particle is the maximum galena particle that can be lifted by the captive bubble with the utmost care if the oil layer is considerably reduced below this Cattermole thickness. This particle lifts instantly but is seen to be more easily detached than the 6 mg. particle.

The 20 mg. particle is the maximum that can be lifted by a free moving bubble when the oil layer is about one one-hundred-thousandth of an inch thick. It lifts readily but a still less vigorous movement detaches it.

The 40 mg. particle is the maximum that can be lifted when clean or thoroughly deoiled. The lift is at first un-

certain because of slight contamination of the bubble, and the particle is easily detached.

“2. Oil globule fails to pick up even light metallic particles. Air bubble picks up similar particles many times as heavy” (p. 4541).

A large oil globule, made in and manipulated by the bubble holder under water attaches itself to and then breaks away from and fails to lift a galena particle weighing 5 mg. and an aluminum punching weighing 16.7 mg. A clean air bubble, similarly manipulated, picks up a galena particle weighing 30 mg. and an aluminum punching weighing 54 mg. The weakness of oil attachment to mineral in water as contrasted with air attachment to mineral in water is thus clearly shown.

“3. Air bubbles do not readily attach themselves to oil globules and have slight if any lifting power when attached” (p. 4545).

A galena cube at the bottom of the vessel weighing 40 mg. has placed upon it a dome of oil. A captive air bubble is brought down in repeated contact with it. The oil flashes over the inner surface of the bubble and forms a lens at the bottom of the bubble, but stretches out in a neck and breaks away as the bubble rises and the particle is not lifted. The air bubble robs it of part of its oil. The lifting force is the surface tension of the oil-water interface and is too weak to lift the particle.

“4. Air bubbles do not attach themselves to metallic particles coated with sufficient oil to produce adhesiveness (p. 4547).

“5. Air bubbles do not attach themselves to metallic particles coated with sufficient oil (cottonseed) to produce adhesiveness” (p. 4548).

Here we have a clean aluminum disc weighing 50 milligrams and two aluminum discs weighing 25 milligrams each and oiled to Cattermole proportions, that is with a layer which, with material ground to 80 mesh, would require between 4% and 8% of oil on the weight of the mineral and which produces a layer of oil about 30 one-hundred-thousandths of an inch thick. The captive air bubble lifts the heavy and clean particle and successively fails to lift the two lighter oiled particles. One oiled particle is lifted by tweezers and placed upon the other oiled particle and adheres to it so strongly that it is shown to lift it. Thus it is demonstrated that there is sufficient oil on the oiled particles to serve as a medium of attachment to other particles. The oil is the attaching medium. This is also true when air bubbles are applied to particles oiled in at least Cattermole proportions. The air bubbles do not attach themselves to the metallic particles, but the attachment is of the kind shown in the preceding pictures, experiment 3, wherein the oil flashed over and coated the inside of the bubble, and the attachment was that of the oil lining of the bubble to the oil coating of the particle, a weak oil neck attachment of little strength.

“6. Air bubbles do not attach themselves to metallic particles coated with sufficient oil (oleic acid) to produce adhesiveness” (p. 4550).

This repeats the last experiment, with a change from cottonseed oil to oleic acid.

“7. The unlimited carrying power of air bubbles as compared with oil.

“Air bubbles in water lift pieces of aluminum one inch in diameter, .05 inch thick” (p. 4550).

In this experiment a truly giant captive air bubble is held down by a large bubble holder and a magnified example is given of the direct attachment of a clean piece of metal for an air bubble. This experiment was performed in court (Vol. 7, pp. 4184-4185; pp. 4194-4195). This particle weighs $1\frac{7}{8}$ grams, 1875 milligrams (Vol. 8, p. 4551), but the increase in the size of the air bubble made it possible to lift it, and this shows that when air bubble and particle are both greatly increased in size, we may actually see the operation and measure the lifting forces, even though in the actual operation of the process both the air bubbles and the metal particles are so minute as to be scarcely visible and the water so clouded by the gangue that very little can be seen. In the court experiment at first this large aluminum disc was not lifted, the laboratory conditions of cleanliness not being present (p. 4185). The particle was washed and thereafter was lifted (p. 4194), and it was clearly seen that the particle and bubble were directly attached and the clean metal surface, from which the water had retreated, exposed at the inner face of the bubble, although the particle being not quite clean there were a few little globules of water lying on the surface of the particle. In the pictured experiment laboratory conditions of cleanliness were observed and the fingers did not touch the disc. The giant bubble lifts the large disc, and it is seen to be firmly held, although swaying from side to side and bumping against the side of the bubble holder.

“8. Same aluminum piece suspended by a fine thread lowered through water to show pliability of the thread” (p. 4553).

The title explains the pictures, wherein the large disc is lowered through the water and allowed to rest on supports at the bottom of the vessel, whereupon the threads sag, showing their pliability.

“9. Same aluminum piece lowered through oil layer on water showing absence of oil-carrying power” (p. 4553).

The disc is lowered through a layer of oil, which fails to carry it, although it attaches itself to the particle, and draws out into a neck, giving an excellent illustration of the operation of the necking off of the body of oil as it fails to carry a metal particle.

“10. When air bubbles lifting metallic particles meet the thinnest possible oil layer they drop the particles” (p. 4556).

Here we have to the left a galena particle weighing 29 milligrams, in the middle a number of small galena particles of about 40 mesh, and to the right a punched aluminum disc weighing 54 milligrams. These are successively raised by clean bubbles and carried to the oil layer on the surface of the water, which is the thinnest layer it is possible to obtain. The moment the galena particle reaches the oil, its attraction for the air bubble is so diminished that it sinks. The 40-mesh particles are retained for a time by the oil layer, but sink in a mass like an inverted waterspout, illustrating overloading, just at the end of the experiment. The aluminum disc sinks as soon as it reaches the oil.

Microscopic examination of the pictures shows that the large galena particle sank in one-fourth of a second after the bubble had passed through the oil layer. A few of the fine particles immediately dropped, too quick-

ly to be seen, and the others gather in a clot and hang for a few seconds. The aluminum disc quickly slid down to the lowest point on the oil film and fell without interruption to the bottom of the cell.

“11. Minute excess of oily mineral frothing agent causes air bubbles to drop metallic particles” (p. 4562).

Here a galena particle weighing 25 milligrams and an aluminum punching weighing 54 milligrams (each about one-half of the maximum lift) are successively lifted and suspended by captive air bubbles. A minute amount of oily frothing agent, three-tenths of a milligram, is then applied to the surface of each bubble. It flashes over the inner surface of the bubble, destroys the direct attachment of the bubble for the metal particle, and causes the metal particle to drop to the bottom of the vessel. Thus we see how oil acts as a robber of air bubbles and destroys the powerful direct attachment.

“12. Air will not attach to mineral enveloped in oil. Finely ground mineral particles less than 200 mesh (.0029 inches, .005mg.) are touched with air bubbles in pine oil. No lift whatever” (p. 4566).

This experiment was also performed in court (pp. 4225-4229, Qs44-47), and is very important as demonstrating that, in a mass of oil, air bubbles have no attachment or lifting power whatsoever for metal particles, even the finest metallic dust. It and the preceding experiments explain how useless air bubbles become in an oil layer, such for example as Kirby's, even though they may assist the buoyancy of oil particles to rise into the oil layer. The moment the surface tension of an oil-water interface, weak though it is, is no longer

effective, and the metal particle is in a body of oil, all attraction of an air bubble and a metal particle is destroyed.

This experiment as pictured shows repeated applications of the air bubble to the fine metallic particles immersed in the oil without the faintest trace of attachment to the air bubble. Dr. Grosvenor also states that he has tested this with other oils and other minerals and it has given exactly the same result.

“13. Magnified view of clean air bubble in pine oil. No mineral attached” (p. 4567).

This picture shows the illuminated under surface of the bubble of the previous pictures taken immediately after it was last withdrawn from contact with the metal, and that there is not a speck of dust upon its surface.

It may be noted here that Professor Beach theoretically determined that under the conditions of these pictures the air bubble would pick up the metal particles and that the metal particles would add to the viscosity of the oil-air interface, this wholly erroneous theoretical determination being based upon his contact angle theory (Vol. 6, pp. 3099-3101, XQs144-146). This conclusion he reached after drawing diagram 20 (Defendant's Exhibit No. 147, Vol. 9, p. 5163), which well illustrated the uselessness of such theoretical deductions as defendant's scientific experts presented.

“14. De-oiling of the galena particles. Kerosene rapidly removed. Three sizes shown in pine oil and water, 6 mg., 16 mg. and 20 mg.” (p. 4568).

Experiments of this nature were performed in court (Vol. 7, pp. 4188-4194) and they show how intense agi-

tation and aeration remove the oil from over-oiled metal particles. A stream of bubbles was played upon an immersed oiled particle and robbed the particle of its oil, and as the oil coating diminished the particle commenced to show activity, until finally the bubbles lifted the particle. In the court experiment the oil gathered on the surface of the water, and when the air bubbles lifted the particle it was re-oiled and had to again be de-oiled by air bubbles before the air bubbles could again lift it. The pictures well show de-oiling of the particles by the air bubbles and the increasing strong attachment for the air bubbles as the particles are de-oiled.

“15, 16, 17, 18, 19. Magnified views of de-oiling 6 mg. particles from kerosene” (p. 4570).

The greatly magnified pictures well show the phenomena of the preceding experiment.

“20. Agitation of water unmodified by a mineral frothing agent produces air bubbles which coalesce, rise and burst. Mineral frothing agents produce small and persistent air bubbles.

“Unmodified water” (p. 4572).

Here it is observed that the moment the agitation is stopped the bubbles rise and disappear.

“21. Magnified view of unmodified water” (p. 4573).

This experiment demonstrates how impossible air froth flotation is in pure water. The air is flowed into the water through a porous medium, alundum, with very fine pores, but the bubbles grow rapidly, coalescing with explosive violence, and the large bubbles are so weak that they do not even maintain spherical shape, but are extended horizontally into egg form. The rapidity of

coalescence was so great that the normal rate of moving pictures, about 16 per second, had to be changed to about 120 per second. These pictures were exhibited at about 12 per second, and thus it was possible by reason of the slowing down to see these operations of coalescence, or at least their results. Although these clean air bubbles have a strong attachment for metal particles, they would have about as much chance of remaining attached as a beetle of hanging on to a stick of exploding dynamite.

“22. Water modified by oleic acid” (p. 4576).

Here a minute amount of oleic acid has been added and the water modified thereby, and we see persistent minute bubbles capable of doing the work of froth flotation.

“23. Magnified view of water modified by oleic acid” (p. 4576).

Here we can see not only minute persistent air bubbles, but cloudy masses of bubbles so minute that they cannot be individually seen. The striking difference between these pictures and those of bubbles formed in unmodified water under the same conditions enables us to comprehend how the modifying action of oleic acid produces useful metal-carrying air bubbles.

“24. Water modified by pine oil” (p. 4578).

Here we have a mineral frothing agent, partly oily frothing agent and partly soluble frothing agent, and we see the persistent minute air bubbles and the cloudy effects of bubbles too small to be individually seen.

“25. Magnified view of water modified with pine oil” (p. 4578).

In this magnification we clearly see the typical smoky or forest fire effect of the extremely minute bubbles, as well as the persistence of those minute bubbles which are large enough to be seen as thus magnified.

“26. Kerosene oil not a frothing agent” (p. 4579).

Here first a minute amount, .05%, and then a larger amount, .49%, of kerosene was added to water. The bubbles rise quickly and burst, and the cloudiness is due only to emulsified oil—extremely minute oil globules—and not to air.

“27. Kerosene oil not aerating agent, but is itself emulsified” (p. 4580).

This is a view of the same emulsion after it has stood for an hour, and shows that the cloudiness is not due to fine air bubbles, but is due to oil emulsion, and these pictures well show the persistence of such an emulsion.

“28. Magnified view unmodified water in presence of kerosene oil” (p. 4580).

At first .05% of kerosene oil was added, then 5%. These magnified pictures clearly show large, quick-coalescing bubbles, just as in the case of pure water, and show how useless kerosene is as a mineral frothing agent.

“29. Pine oil excellent frothing agent with kerosene or alone” (p. 4581).

Here .1% of pine oil is added to the kerosene emulsion and now the agitation produces a wholly different result, fine and persistent bubbles being formed.

“30. Magnified view of water modified by pine oil in presence of kerosene” (p. 4581).

Here we see that the presence of the kerosene does not in any way interfere with the production of the fine clouds of bubbles or the forest fire effect as well as the persistent fine bubbles. The presence of the kerosene can hardly be said to modify this effect.

“31. Magnified view of water modified by pine oil in presence of kerosene and Jones fuel oil” (p. 4582).

Here we have substantially defendant's oil mixture, and the pine oil performs its modifying function just as it did alone, and just as it did in the presence of kerosene, the inert oils not having substantially changed the air bubble result.

“32. Water modified by phenol” (p. 4582).

This is the first set of pictures of a wholly soluble frothing agent. This extreme fineness of the air bubbles, producing cloud effects, is evident even in this not substantially magnified view.

“33. Magnified view of water modified by phenol” (p. 4582).

Here we have forest fire effect and persistent minute bubbles which characterize all modifying agents. The effect is much the same as with oleic acid, but there is a great improvement in the fineness of subdivision.

“34. Water modified by cresol” (p. 4583).

These pictures look quite the same as the unmagnified phenol pictures.

“35. Magnified view of water modified by cresol” (p. 4584).

These pictures look quite the same as the phenol magnified pictures, although there are recognizable differences, the smoke having a somewhat coarser granulation. The bubbles separately visible are minute and persistent.

“36. Water modified by amyl acetate” (p. 4584).

This is the soluble frothing agent of the specific example of the soluble frothing agent, patent No. 962,-678 and in this unmagnified view we have the same smoke effect as with the other soluble frothing agents.

“37. Magnified view of water modified by amyl acetate” (p. 4585).

The appearance of individual minute persistent bubbles and clouds of very fine bubbles is here quite the same as with phenol and cresol.

“38. Water modified by acetic acid” (p. 4585).

In this unmagnified view we have quite the same conditions as with the other soluble frothing agents. This substance, an excellent mineral frothing agent, is not an oil nor is it usually associated with oils and is most familiar as the dominating constituent of vinegar.

“39. Magnified view of water modified by acetic acid” (p. 4586).

Here we have the characteristic fine subdivision of the air and the ordinary characteristics of soluble frothing agents, with an excellent forest fire effect.

“40. Practical results. Air bubbles produced in modified water pick out metallic particles and reject gangue particles” (p. 4586).

Here the water is modified, containing .02% of cresol and .05% of sulphuric acid, and the effect of the captive bubble in picking up metallic particles and rejecting gangue particles is shown. The metallic particles are galena (lead sulphide), pyrite (iron sulphide) and blende (zinc sulphide). The non-metallic particles are quartz, feldspar and calcite, typical gangue. The metallic particles are much the heavier, and the larger sizes and surfaces of the gangue particles give the air bubble a better chance for attachment. The air bubbles seize upon the metallic particles one after another and lift them and are detached only by violent jerks. The gangue particles are not lifted at all.

“41. Oil froths” (p. 4588).

The pictures show an oil emulsion froth or magma made with about 16 or 17% of oil to ore (p. 4713, XQ14), and show the interior structure of this floating material by light transmitted directly through it. It is mainly a mass of oil with metallic particles entrapped in it, and air bubbles are also entrapped in the oil, and as the floating mass is gently pressed and shifted between glass plates, these air bubbles escape and at the end of the experiment a sufficient number of these air bubbles has escaped to increase the density of the floating mass just above that of water and so it sinks. This well represents practical conditions where absolute quiescence of the water surface is impossible and the air bubbles that would be entangled and held in such a mass of oil and metal in a glass jar will escape and so diminish the buoyancy of the mass that it will not continue to float. The amount of oil is insufficient to float

the entrapped metal by the buoyancy of the oil. The method of holding the metal particles is substantially the same as in an oil-buoyancy float.

The separate enlarged photographs of this film are in evidence as Plaintiffs' Exhibits 278-281 (0¹, 0², 0³, 0⁴, Vol. 9, pp. 5446-5449, but so poorly printed that the original photographs in evidence should be examined); the last showing the sinking mass now nearly deprived of air bubbles.

"42. Air froths" (p. 4590).

Here we have an air froth of the process in suit made with about .02% of oil to ore (Vol. 8, pp. 4712-4713, XQs12-13), and illuminated in the same way as the oil froth, but manipulated much more violently.

In the moving pictures metal particles are seen dropping from the bubbles to which they are attached and being caught by other bubbles and the attachment of the metal particles to the air bubbles is quite clearly shown. The air bubbles are seen to act like rubber balls, squeezed together and catching and holding any falling metal particles. The effect of the agitation is a rearrangement of these bubbles. They persist in holding on to their metal particles notwithstanding the hard usage to which they are subjected. These pictures well show that in an air froth the metal particles are firmly gripped and held by the air bubbles just as the preceding pictures showed that with an oil froth or magma the metal particles are not held at all by the air bubbles; but that the air bubbles merely are weakly entrapped in a slippery mass of oil.

Five enlarged pictures of this portion of the film are in evidence as Plaintiffs' Exhibits 282-286, marked A1, A2, A3, A4, A5, respectively (Vol 9, pp. 5450-5455), but here also the original photographs should be examined. They show how the agitation has caused a complete rearrangement of the air bubbles without in any manner destroying the character of the structure, which remains a mass of air bubbles firmly carrying metal particles.

APPELLANT'S PHOTOGRAPHS OF FROTHS AND MAGMAS.

By way of offsetting the effect of appellees' moving pictures, most of which were used in the Miami case and which undoubtedly helped the courts in that case, appellant prepared for and gave a magic lantern exhibition with external views of various froths and magmas shown by reflected light and successfully concealing the interior structures of the floats exhibited. As Dr. Grosvenor testifies the photographic work was excellent, but the conditions chosen were such as to exhibit only surface similarity and give no information as to structure. Therefore in his opinion they were of no technical value whatsoever (Vol. 8, p. 4708, Q4). About the only point made as to these photographs was that they in some instances showed two spots of reflection on the bubble, which was taken to indicate an unbroken inner surface of the bubble, but Dr. Grosvenor testified that in his investigations he has made hundreds, if not thousands, of photographs of the actual interiors of the bubbles, and that the principal difficulty that he has met with has been the great number of re-

flections (Q5). Mr. Higgins testifies that he has examined these photographs carefully and with magnification, and that they do not show a characteristic picture at all, and that he cannot see that they are of any use whatever (pp. 4729, 4730, A2).

Most of these photographs were taken of floats produced by appellant's wonderful oil mixture, or a modification of it, containing crude or fuel oil, kerosene and pine oil, and these, by reason of the presence of a soluble frothing agent, produced aerated floats with varying quantities of oil. The variations were from .4% to 1.5%. He also used pine tar oil in variations from .4% to 2%, and this also contains soluble frothing agents (Higgins, p. 731, Q9). He also used wood tar oil with smaller variations, and this also contains soluble frothing agents (*idem*). He used California eucalyptus, which is an essential oil and contains soluble frothing agents (Qs5, 6), and which it may be added has never proved of any value in flotation, although the Australian Eucalyptus Amygdalina has been extensively used in Australia in the froth flotation process (Qs3, 4). With 25% of alleged kerosene he obtained a floating magma, but it later turned out that this kerosene was contaminated with pine oil, as fully set forth herein under the heading Kirby patents. He also obtained a float with 5% of a smelter fuel oil with a very low grade flaky molybdenite ore, which was in fact a magma (Q11). Whether or not this fuel oil was likewise contaminated does not appear, but it is certainly open to suspicion since it was obtained from appellant's plant where the oils are poured into tanks without regard to

their previous contents and without cleaning the tanks, as testified to by Mr. Dosenbach (Vol 7, p. 3889-3891, XQs149-151).

Mr. Phillips' speed of agitation was terrific. He thought it was about 1800 revolutions per minute, although he admitted that he did not know (Vol. 6, p. 2918, Q219), but Mr. Higgins measured it and found it was between 9000 and 10,000 revolutions per minute (Higgins, Vol. 8, p. 604, Qs410, 411).

These experiments and photographs, even when not open to suspicion as to the purity of the materials used, were of no value whatsoever as to any question in issue herein, and the whole proceeding was a weak effort to offset the really instructive moving pictures shown in behalf of the appellees. They are not referred to in appellant's brief.

THE FINDINGS AND OPINION OF THE DISTRICT COURT.

The Findings.

The District Court in the case at bar found the issue of validity and both the issues of infringement in favor of appellees (plaintiffs) and against appellant (defendant)—that the patent is valid as to all the claims in issue, namely, claims 1, 2, 3, 5, 6, 7 and 12, and also claims 9, 10 and 11 as limited by disclaimer (pp. clxxvii and exxvi) and that the appellant had prior to January 7th, 1917, infringed all of the claims in issue, claims 1, 2, 3, 5, 6, 7 and 12 and claims 9, 10 and 11 as limited by disclaimer, and since January 7th, 1917, had infringed claims 1, 2, 3 and 12 and claims 9, 10 and 11 as limited

by disclaimer (pp. clxxvii to excvii); and the District Court therefrom concluded that the appellees were entitled to injunction and to an accounting of profits and damages, in accordance with the prayer of the Bill and Supplemental Bill, and so decreed (pp. excv to excviii).

The Opinion.

The Opinion in explanation of these findings (pp. clxxvii to exciv) states the issues as novelty, invention, infringement, alleged delay and defects in disclaimer, and estoppel by previous arguments of appellees' counsel.

Novelty and invention are discussed on pages clxxviii to clxxxix; disclaimer on page clxxxix; infringement on page clxxxix to exciv; and estoppel on page exciv.

Novelty and invention as discussed in the opinion below.—On the issues of novelty and invention the District Court calls attention to the fact that those issues were decided by the Supreme Court in plaintiff's favor and against the defendant on the record in the Hyde case (242 U. S., 261), and in that situation and as a fundamental principle touching the consideration of new evidence in the case at bar it says (p. clxxxviii) :

“If it be conceded that new evidence might warrant and demand that a trial court hold invalid a patent by the Supreme Court held valid, such evidence must be unequivocal, clear and convincing, in quality and quantity that inspires confidence and produces conviction that the patent is invalid and that the Supreme Court would so determine beyond a reasonable doubt.”

Of the new evidence in the case at bar the court says (p. clxxxiv) :

“The great mass of new evidence herein is but cumulative of the Hyde suit. The only new publication is the California Journal of Technology detailing a suggestive but rather misleading and abandoned experiment sufficiently referred to and disposed of in the Miami suit.”*

Summing up as to the new evidence the court says (p. clxxxix):

“Not only does it fail here [i. e. to inspire confidence and produce conviction that the patent is invalid and that the Supreme Court would so determine beyond a reasonable doubt] but it strengthens the conviction that the patent is valid.”

In reaching this conclusion as to the new evidence in the case at bar and its effect on the issues of novelty and invention, the court first refers to the more recent history of the invention and discusses the nature of the invention.

As to the more recent history, the court points out that the evidence in the present suit (p. clxxviii)

“discloses that though the use of the process is very wide, extensive and growing, its simplicity, economy and success still surprise and gratify the metallurgical world.”

*In the Miami suit the same patent was involved as here and two later patents and the same prior art was set up by the defendant and in addition the California Journal of Technology. In the District Court there (237 Fed. 609) the California Journal of Technology is discussed on p. 623. It was there held that this article while suggestive did not negative invention in the patent in suit, that the experiments were mere laboratory tests and did not disclose the inventive idea and were in fact misleading. On appeal in that case (244 Fed. 752) the California Journal of Technology is referred to on p. 755 (pamphlet opinion, p. 6). After considering the entire prior art including the California Journal of Technology the Circuit Court of Appeals for the Third Circuit announces its conclusion, p. 756 (pamphlet opinion, p. 6), that the patent here in suit was not anticipated and involved a patentable invention of a high order of merit. The California Journal of Technology was not before the Supreme Court in the Hyde case, but it was, even more than Froment (which was there considered and dismissed as little more than a laboratory experiment and of little use in practice, 242 U. S. 261), a mere “laboratory experiment,” and was never even tried in practice.

As to its nature, the court points out that the evidence in this suit discloses the fact that (p. clxxviii)

“its laws or principles of operation still interest and puzzle the scientist,”

and quotes the appellant’s witness, Prof. Bancroft, of Cornell:

“In the beginning it was very little knowledge and mostly guesswork and since then there has been every year a little more knowledge and still a great deal of guesswork.”

And the court thus comments on this (p. clxxviii):

“Though speaking for himself alone, the learned doctor’s estimate might well be applied to all, practical layman and expert scientist alike.”

Nevertheless, the court sets out what conclusion present knowledge warrants (p. clxxix):

“At the same time, though heretofore somewhat ambiguous and obscure, present knowledge warrants the conclusion that the gist of this remarkable and valuable process and the actual discovery and invention are that whereas theretofore in ore concentration, air had been used in desultory and fugitive bubbles as a make-shift incident of, and supplemental to, oil and skin flotation, air can be made to do all the work by creating in water-ore pulp modified by a suitable oily contaminant, an infinitude of bubbles.”

The court finds that the invention is novel, saying (p. clxxix):

“It is the first of its kind and the patent sufficiently discloses it and methods to those skilled in the art.”

The court points out that ambiguity and obscurity have been as much due to the extreme mechanical simplicity of the process as to its novelty and, in an ex-

planation of its laws and principles, the court says (p. clxxix):

“The tendency was to attach prime importance to reduction in amount of oil used, when in fact this is but a necessary incident (for which there are substitutes if not equivalents) to the creation of the infinitude of bubbles that do the work.”

And, continuing—

“Despite this tendency, and to overlook the simple and obvious, the patent fairly clearly sets out the various ways and means to create this infinitude of bubbles and that they do the work.”

“The tests to determine which kind and amount of ‘oily substance yields the proportion of froth or scum desired,’ that flotation is ‘mainly from the inclusion of air bubbles,’ the froth, the agitation, all are so many guides in the patent pointing the skilled operator to and including the infinitude of bubbles and the degree of agitation and amount of soap or oil to produce such bubbles, as surely as the word ‘crystallization’ points to appropriate temperature in *Commercial Co. v. Co.*, 135 U. S. 189, and the words ‘uttered sound’ by the ‘human voice’ to articulate speech in the *Telephone Cases*, 126 U. S. 531.”

The court then considers that part of the new evidence consisting of “learned dissertations upon the philosophy of the process—upon the philosophy of bubbles, the heart of it, by Professors Bancroft of Cornell, and Taggart and Beach of Yale. and Drs. Sadtler of Philadelphia and Grosvenor of New York”. The court notes (p. clxxxi) that the quality of oil is of the first importance in the process but another quality of less importance is the preferential affinity of oils for metal-liferous matter over gangue, remarking that this is of less importance because it is now known that, given

another contaminant than oil which possesses the same bubble-making quality, but does not have the preferential affinity for metal over gangue, flotation is equally successfully achieved.*

The court proceeds (p. clxxxi):

“Air also possesses this ‘preferential affinity’ and in view of the foregoing it well may be that the capture as well as the flotation of the metallic particles is more due to the great volume of air than to the infinitesimal oil. That in this process air without oil cannot capture and retain the metallic particles, seems due to its inability to create bubbles without oil. And why this capture in any case, is still of the unsolved phenomena of the process.”

The court points out that there are “critical proportions” of any oil used, but that this is not a sharp divide but rather a broad one, depending upon many circumstances mentioned and the court adds (p. clxxxii):

“With excess oil, but not enough to defeat bubbles altogether, though of fair aspect to the eye, the bubbles will not do the work. In the excess oil in the films the metallic particles do not cling, but swim or slide to the bubble’s lower surface, ‘neck off’—detach and sink. The untechnical workman recognizes there are ‘critical proportions’ of oil, and small deviation from the pre-determined amount in the feed, whether more or less, manifests itself to him in the appearance of the froth and poorer results, and he knows and remedies the error in oil.”

The court finds (p. clxxxiii):

“Metallic content of ore seems of little importance,—sometimes seems to require oil inversely.”

*The reference here is to the later discoveries of appellees’ inventors that certain soluble re-agents when completely dissolved in the water of the pulp have the same froth-forming quality essential to flotation. See Patents Nos. 962,678 and 1,099,699 at issue and described in the Miami case (237 Fed. 609, and 244 Fed. 752), the former being in evidence here as Defendant’s Exhibit 218, Vol. 9, pp. 5274-5277.

And an example is given. From that example another conclusion is drawn as follows:

“It is the air and not at all the oil that floats the mineral, noting that in the first of this example 211 pounds of zinc are floated by air bubbles in the creation of which only .7 pounds of oil is used.”

Three hundred pounds of zinc floated by the use of one pound of oil! Manifestly, as the court notes, this is not oil-lift through the pulp or oil-flotation on the surface of the pulp, but air-lift and air-froth flotation.

The court then observes that the manner of introduction of the air particles and the method of agitation cannot be vital, provided “the oil-coated mineral matter forms into a froth”.

And the court speaking of agitation says:

“And it is all one whether this be applied agitation or self-agitation—the agitation set up by the air particles themselves in merely rising through the mass and thereby coming in contact with both water and oil, all co-acting to form bubbles which capture the metal.”

The court concludes its consideration of the philosophy of the process as follows (p. clxxxiii):

“The mineral particles, either oiled before or by contact with bubbles, attach to and enter the viscous film of the bubbles. The particles also increase the viscosity of the bubble films, armor them and increase their stability, perhaps as stays that, decreasing the area of unsupported surfaces, increase the latter’s ability to resist rupture.”

The court, dismissing without comment the California Journal of Technology, other than the reference to an adoption of the reasoning of the opinions in the Miami

suit on that subject, considers the new evidence (p. clxxxiv):

“that progress in the process and methods of operating it, now discloses that with some ores and some oils or mixtures of oils, the process can be fairly successfully operated with one per cent and more of oil.”

In this connection, the court finds it proven “practically without conflict” (p. clxxxiv):

“that in all the operations with this process not to exceed .2 per cent of oil is used, save by defendant and others in like situation, and only since the decision in the Hyde suit, and solely to avoid infringement; that some oils are effective and more are ineffective to operate the process; and that the excess oil used is useless, wasted and harmful.”

The court then considers in detail the appellant’s contention (p. clxxxiv):

“that this evidence demonstrates the process lacks novelty and invention, and that because of it the record is substantially different from the Hyde suit, the decision there should not control here, and the patent is and ought to be held invalid.”

The court found this contention

“without support in the patent and Hyde decision.”

As to the patent, the court below analyzes the specification and claims on pages clxxxiv and clxxxv and points out that the specification speaks only of the proportion of oily substances being “considerably reduced” as compared with the proportions previously employed in the Cattermole process—

“considerably reduced—say to a fraction of one per cent on the ore;”

that the proportion varies with different ores and different oils,

“and so it is necessary to test ‘to determine which oily substance yields the proportion of froth or scum desired;’ ”

that an example of a particular ore Broken Hill ore and a particular oil (oleic acid) is given wherein the proportion of oil prescribed varies from a very small fraction of one per cent. (.02) up to one-half of one per cent. (.5) on the weight of the ore.

As to the Supreme Court decision, the court below analyzes it at pages clxxxv to clxxxvii, as follows:

“In upholding the patent the Supreme Court says that ‘as described and practiced’ the process consists ‘in the use of an amount of oil which is “critical” and minute as compared with the amount used in prior processes, “amounting to a fraction of 1 per cent on the ore,” and in so impregnating with air the mass—by agitation—as to cause to rise to the surface a froth—which is composed of air bubbles with only a trace of oil in them, which carry in mechanical suspension a very high percentage of the metal;’ that ‘it differs so essentially from all prior processes in its character, in its simplicity of operation and in the resulting concentrate, that we are persuaded that it constitutes a new and patentable discovery’; that the facts are not overstated by Liebmann that ‘the present invention differs essentially from all previous results. It is true that oil is one of the substances used, but it is used in quantities much smaller than was ever heard of and it produces a result never obtained before * * *,’ that the court is convinced ‘that the small amount of oil used makes it clear that the lifting force which separates the metallic particles of the pulp from the other substances of it is not to be found principally in the buoyancy of the oil used as was the case in prior processes, but that this force is to be found, chiefly, in the buoyancy of the air bubbles introduced into the mixture by

an agitation greater than and different from that which had been resorted to before and that this advance on the prior art and the resulting froth concentrate so different from the product of other processes make of it a patentable discovery as new and original as it has proved useful and economical; that the court agrees with the House of Lords decision; that the process is not one before described, but a new method in which flotation is by the 'buoyancy of air bubbles;' that tests to determine the necessary 'amount of oil and the extent of agitation,' and 'the range of treatment within the terms of the claims,' satisfy the law; but that while the patentee 'discovered the final step, precedent investigations were so informing that this final step was not a long one and the patent must be confined to the results obtained by the use of oil within the proportion often described in the testimony and in the claims of the patent as 'critical proportions' amounting to a fraction of 1 per cent on the ore' and therefore—the patent is valid as to claims Nos. 1, 2, 3, 5, 6, 7 and 12, but invalid as to claims 9, 10 and 11."

The court then states the following conclusion:

"It seems clear neither patent nor decision undertakes to say the process depends upon less than 1 per cent of oil or is inoperative with 1 per cent or more of oil."

Summing up as to the notion that the invention resided in the use of a fraction of 1 per cent. of oil on the ore, the court says (p. clxxxvii):

"It is true that in the beginning and during the Hyde suit the patentees inclined to so believe or at least believed better results would be obtained with a fraction of 1 per cent. of oil. Perhaps limited investigation and experience with a few ores and oils justified the belief. Indeed, all experience to date, plaintiff's, defendant's, strangers', demonstrates that with any ore and any efficient oil, less than 1 per cent. of oil gives better results, all circumstances considered. The 'critical proportion' referred to seems absent in terms from the patent, and

ought not to be adversely inferred in disregard of construction in favor of the patentee where the patent is ambiguous. The patent describes oil 'considerably reduced,' and refers to a 'fraction of 1 per cent.' by way of example. And though some claims limit oil to such fraction, and, a limited range within it, others are for 'a small quantity', and for that reason held invalid by the Supreme Court. With the later knowledge of this suit it is doubted that such would be the decision now. It is to be observed that this limitation of the patent indicates the Supreme Court believed the process might be operative with 1 per cent. and more of oil, and contemplated that this would not defeat the patent, but might affect infringement. If the patent is limited to the use of a fraction of 1 per cent. of oil, that the process can be operated with 1 per cent. and more is not material to validity, though it may be to infringement. For if a patentee limits his claim voluntarily, or because he does not know the extent of his invention, he abandons the excess and the patent is valid to the extent of the claim."

The general conclusion of the court below as to novelty and invention is that the new evidence in the case at bar over that in the Hyde case

"strengthens the conviction that the patent is valid."

Disclaimer as discussed in the opinion below.—The subject of disclaimer is dealt with on page clxxxix. The court holds that the disclaimer "was timely filed," noting that it was within the time limited for petitions for rehearing in the Supreme Court.

As to the substance of the disclaimer, the court holds that it fairly conforms to the language of the Supreme Court decision. Under that decision, the court points out, claims 9, 10 and 11 included what the patentees were entitled to and more.

“The decision pointed out the excess. The patentees disclaim the excess. They can safely rely upon the decision and a disclaimer conforming to the language of the decision is sufficient.”

Infringement as discussed in the opinion below.—On the issue of infringement the court deals first with the period prior to January 7, 1917, and later with the period subsequent to that date.

As to the period prior to January 7, 1917, the court points out that the appellant admits infringement before suit brought and up to that date, and the court summarizes the testimony as to the enormous and profitable extent of that infringement, and from the figures year by year it finds (p. cxc)

“Progress is indicated by leaner ores, less oil, higher grade concentrates, greater recoveries, all coincident with advancing time.”

The court adds

“It is noted that the process is responsible for advance in methods, devices, and machines for its operation.”

And the court briefly describes the process constituting the admitted infringement from a date prior to the filing of the original Bill down to January 7, 1917 (p. cxc).

As to infringement after January 7, 1917, the court points out that (p. exci)

“the defendant’s methods are as before, save pneumatic as well as mechanical agitation is employed in the lower four cells of the pyramid. Some spitzkasten are blocked, an additional cleaner operation is used, and from which

for some unexplained reason 8.65 per cent. zinc tailings go to waste, and oil in amount 1 per cent. and more on the ore is used."

Considering this question of infringement (the only contested question of infringement in the case) the court points out, first, the practical effect of the use of the excess oil. It says (p. exci):

"Defendant not very insistently claims results for this latter period are more profitable than for the former, but plaintiff's analysis, neither denied nor criticized, and beyond both, of defendant's reports and tabulations makes manifest the fact is otherwise to the extent of about \$1.75 per ton of ore—an enormous loss on 45,000 tons monthly"—

a loss of the order of \$1,000,000 a year.

And the court adds:

"There is considerable like testimony in reference to operations by other infringers."

These losses have practically no relation to the increased cost of the oil. They are quite apart from that and belong to a different order of magnitude.

The court points out that in view of the very large operations, investigations and experiments through several years by the great infringing concerns, it is incredible, if the use of 20 pounds of oil per ton of ore results in more profit, that they would have waited to discover the fact until after the Supreme Court decision in the Hyde suit.

The Court says:

"Defendant practically admits that it now uses the present amount of oil merely to avoid the patent. * * * The evidence likewise persuades.

“If the excess of oil,” says the court (p. excii), “were effective and useful and not inert, useless and harmful, it would be without the claims of the patent, would be of that the patentees abandoned to the public, and would involve no infringement.”

Considering next the bearing of the Supreme Court decision on this question of infringement (p. excii) the lower court, while criticizing appellees’ argument based on the use of the words, “the results obtained” as meaning like or same results, interprets that Supreme Court opinion as follows (p. excii):

“It is believed, however, that the court employed the word ‘use’ in its, or the ordinary, sense of beneficial service.”

The District Court thus interprets the Supreme Court decision, where that court says:

“the patent must be confined to the results obtained by the use of oil within the proportions,” etc.,

as meaning

the patent must be confined to the results obtained by the beneficial service of oil within the proportions, etc.

that is to say,

The patent must be confined to the results obtained by the use in beneficial service of oil within the proportions, etc.,

beneficial service meaning that service or function which achieves the mineral-froth flotation.

The District Court then lays down the proposition.

“Patent law is not concerned with the useless, and a valuable result sought is not ‘obtained’ by but *despite* the use of an excess of an essential ingredient, which excess renders no or ill service.”

Turning to the evidence the court says (p. excii):

“From the evidence it appears the larger part of the oil used by the defendant and all in excess of a fraction of 1 per cent on the ore, if not inert is ineffective, wasted and injurious to the process and results. Before January 7, 1917, defendant used only pine oil and about 1.43 pounds per ton of ore, with excellent results. Since said date it uses a mixture of 20 to 24 pounds of oil per ton of ore, made up of 18 per cent. of pine oil, 12 per cent. of kerosene oil, and 70 per cent. of fuel oil, with poorer results. The kerosene and fuel oil are petroleum.”

Reviewing the evidence as to these petroleums and their effect in the process the court says (p. exciii):

“As before stated many oils are ineffective to operate the process and that is because they have not the quality that contributes to bubble-making. What this quality consists of, wherein it lies, does not appear. With these ineffective oils agitation will not produce froth and so there is no flotation of the metallic particles. One of defendant's witnesses testifies that in the laboratory and plant of the Utah Copper, one thousand oils have been tried, of which two mixtures give satisfaction. Petroleum seemed generally ineffective by the evidence of both parties, though some of defendant's witnesses testify to sometimes successful experiments with them. Incidentally, there is suspicion that with experiments as with figures can be done anything for or against, without impropriety in the operator.”

The court then states from the evidence, and thereby emphasizes the fact, that (p. exciii)

“Some petroleums are used in limited quantities but always in combination with a recognized bubble-making oil, and only, it is said, for a somewhat bubble stabilizing effect.”

The court then reasons as follows (p. exciii):

“Defendant's present mixture of oil contains more pine oil on the ore than it used alone before January 7, 1917.

The other factors the same, it is obvious the excess petroleum in the mixture are responsible for the poorer results."

The court then states its conclusion of fact (p. exciii).

"Defendant uses the patent process, uses plaintiff's invention of ore concentration by air bubble flotation, uses the same elements in the same combination in the same way with the same function to the same, but poorer, results,"

and its conclusions of law (p. exciv):

"and, exceeding the patent claims in reference to one ingredient (oil) uselessly, wastefully and injuriously and merely with intent to avoid the letter of the patent, does not avoid infringement. The addition of the excess oil no more adds to or changes the process, no more avoids infringement, than would the addition of milk or other useless substance not a part of the process. The excess oil either exercises no function or less efficiently exercises the same function in the same way as the limited oil and to the same but poorer results."

And the court continues with the more general proposition of law (p. exciv):

"To secure to patentees their invention, the law looks quite through mere devices and forms, to the substance of things. And if in substance the invention is taken, if the thing that does the work is taken, all devices to evade the letter of the patent avail nothing to escape the consequences of infringement. Neither principle nor authority to the contrary, is cited or known to the court."

Estoppel as discussed in the opinion below.—The matter of estoppel as affecting infringement is quickly disposed of, the court merely saying that neither in pleading nor proof do the elements of estoppel appear.

MISREPRESENTATIONS TO THIS COURT IN THE HYDE CASE.

The decision of this court in the Hyde suit (214 Fed. 100) appears to have been founded upon the belief by this court that the prior art disclosed processes capable of producing mineral froths substantially the same in all characteristics as that which was in fact first produced by the process of the patent in suit. Upon that belief as to what was disclosed in the prior art this court said that the invention was a mere matter of degree. This is summed up in the opinion of this court, as follows:

“The evidence in the case, together with the illustrations thereof afforded by demonstrations of the various processes which were made in aid of the argument before this Court, convinces us that the froths in all these processes is the same, with the exception that there is less oil (as there must necessarily be) in the appellee’s froth than in the others. The froths are all similar in appearance, they all rise to the surface after the same amount of agitation, they all gather with equal efficiency the same quantity of metal, and all may be removed from the surface in the same way” (214 Fed. 106).

These conclusions appear to have been largely founded upon demonstrations made in this court in behalf of the defendant-appellant in the Hyde suit which were exhibited as veritable representations of the prior art.

It appears in the opinion that this court took the Haynes process (British patent 488 of 1860) as one of the processes producing this identical froth. In the trial of the case at bar appellant’s expert Dr. Sadtler admitted that this was a process wherein no froth was produced and the concentrate was in fact produced in

the form of a pasty mass immersed in water (*supra*, p. 173).

This court believed that the Schwarz process (patent 807,503, issued after the invention in suit on an application filed May 27, 1904, before the invention in suit) was a process which produced this identical froth, and a demonstration alleged to show the Schwarz disclosure was exhibited to this court in behalf of defendant in the Hyde suit. That contention has been abandoned by this appellant. At a trial, where everything used and produced is subject to analysis, it is impossible to sustain the argument or demonstration as to the Schwarz patent which was presented to this court by the defendant in the Hyde suit. These are specific instances of arguments presented by counsel for the defendant in the Hyde suit in this court and enforced by demonstrations in the presence of this court which had to be abandoned at an open trial. The arguments were false. The demonstrations were false. This, however, was equally true as to all that was said and as to all the demonstrations that were made in this court in behalf of the appellant in the Hyde suit as to the prior art.

Another patent which this court believed produced the identical froth of the process in suit was the Kirby patent. A demonstration was made in behalf of the defendant in the Hyde suit in this court wherein 25% of alleged kerosene oil was used and wherein a float was produced which looked like a froth. This demonstration was a complete surprise to plaintiffs-appellees. Defendant's expert had testified to making such a demonstration, but plaintiffs' experts had been unable to

reproduce it. The trial was not in open court, and defendant's demonstration had not been made in the presence of plaintiffs' representatives. The mystery of the production of this float that resembled a froth remained unsolved until the trial of the case at bar, when appellees' expert Mr. Higgins, having been supplied on demand with the identical apparatus and materials used in one of these 25% alleged kerosene-oil-Kirby experiments, found that he was unable to reproduce it with some eight specimens of kerosene purchased in the open market, but that by the addition of a minute amount of pine oil, containing a useful frothing oil and a soluble frothing agent, he could reproduce it exactly. He further found that the kerosene specimen used by appellant's witness contained a soluble frothing agent which gave indications of being pine oil, and it was admitted that it came from a tank which might have formerly contained pine oil. This demonstrated that the peculiarity of the experiment is that it requires the presence with the kerosene of some foreign substance which is a soluble frothing agent (*supra*, pp. 209-212). Possibly such impure kerosenes exist and can be found, although appellees have not been able to find them. Certainly experiments in this court in behalf of the defendant at the Hyde trial were carried on with an impure kerosene which contained a soluble frothing agent, however that soluble frothing agent got there. The 25% alleged Kirby experiment was repeated by the defendant in the Supreme Court of the United States, but there plaintiffs were able to show the court the real Kirby apparatus exactly reproduced operating with the real Kirby ore, and the Supreme Court was not misled.

This Kirby apparatus and Kirby ore were not in evidence in the Hyde suit, but had first appeared in the Miami suit, and the experiment was made in the Supreme Court after a statement of that fact, and with the consent of the Justices.

Another patent which this court believed produced the identical froth of the process in suit was the Everson patent. This patent discloses two methods. The first method, which happens to use only 5% of oil, was represented to this court as a froth process, and this court so believed and so stated in its opinion. Appellant's expert Dr. Sadtler in the case at bar admitted that it is merely a paste or pudding process like Haynes, in which gangue was made to exude from a mass of oil and ore by manipulation in a wash basin (*supra*, pp. 174, 175). Everson's second method is a petroleum method using 17% of what is very nearly kerosene oil. An experiment alleged to represent this Everson second method was testified to in the Hyde record in behalf of defendant. It comes within the same category as the alleged Kirby experiment. It was not repeated in this court, the alleged Kirby experiment being referred to as substantially representing it, but it was repeated, with alleged kerosene oil, in the Supreme Court of the United States. It was a false representation of what Everson discloses, and it required a kerosene which contained a soluble frothing agent to produce it. But plaintiff exhibited in the Supreme Court of the United States an experiment in a batea or miner's wash pan (representing vanning or wet table concentration) which exactly followed the Everson dis-

closure and produced an overflow in suspension of oil and metalliferous mineral and absolutely no froth. Here again the experiment shown by the plaintiffs in the Supreme Court was not in evidence in the Hyde suit, or shown to this court, and had first appeared in the Miami suit, and was repeated in the Supreme Court after a statement of the fact that it was not in the record before the court, with the consent of the Justices. The Supreme Court of the United States saw the true Everson process and was not misled.

In the case at bar appellees repeated this experiment exactly reproducing the disclosure of Everson's second method (*supra*, pp. 176, 177).

It may be noted that both the alleged Kirby float and the alleged Everson float exhibited by the defendant were not froths at all, although they looked like froths. They were magmas, masses of oil with metalliferous mineral diffused through the oil, and inflated by air bubbles to which the metalliferous mineral particles were not attached.

This court believed that the Froment process produced the identical froth of the process in suit. Defendant at the argument in the Hyde case in this court exhibited a demonstration wholly unfounded, based upon nothing in the record, and alleged to represent the Froment description, which was a mere fraud and a sham. This was not repeated in the Supreme Court of the United States, but an alleged Froment experiment was shown there by defendant said to correspond to the Froment patents, but in fact corresponding to and representing nothing of the prior art.

In the trial of the case at bar no effort was made by appellant to make any demonstration alleged to represent the Froment description, and the Supreme Court experiment alleged to represent the Froment patents was not repeated.

The above includes all demonstrations made in this court at the argument of the Hyde suit, except an imperfect and spoiled representation of the process in suit. These false representations in demonstration and argument led this court to believe that the froths of the prior art and the froths of the process in suit are the same "with the exception that there is less oil" and that "the froths are all similar in appearance, they all rise to the surface after the same amount of agitation, they all gather with equal efficiency the same quantity of metal, and all may be removed from the surface in the same way". This court was in error as to the facts because it was misled as to the facts.

LAW AS TO INTERPRETATION OF PRIOR ART DISCLOSURES.

Prior art processes should be considered and weighed only in the light of the knowledge of their own day.

The Privy Council case, printed in the Hyde Supreme Court Record, pp. 747-756 (*Ore Concentration Co.*, 1905, *Ltd.*, *v. Sulphide Corporation, Ltd.*, 31 R. P. C., 206), well states the law of England at 750:

"It is a general canon of construction, applicable to all documents, that the document should be construed as if the court had to construe it as of the date of publication to the exclusion of information subsequently discovered. In patent cases the observance of this canon of construction has great importance. It is common, in such cases, to

have a number of documents placed in evidence extending over a considerable period of time, each of which is relied on as disclosing relevant information prior to the date of the patent. If these documents require the assistance of experts to aid the Court in construction, the Court is deprived of the benefit of such assistance if the witness is asked to read the document not in reference to what was known at the date of publication, but to knowledge only acquired at some subsequent date."

Naylor v. Alsop Process Company, 168 Fed., 911, 920, C. C. A., 8th Circuit, Sanborn and Vandevanter, C. Js., and Amidon, D. J., opinion by Amidon, D. J.

Judge Amidon said:

"When it is sought to ascertain the state of the art by means of prior patents, nothing can be used except what is disclosed on the face of those patents. Such patents cannot be reconstructed in the light of the invention in suit, and then used as a part of the prior art."

Judge Amidon then referred to a patent of the prior art which admittedly on its face did not disclose the process in suit, and to the evidence in behalf of the defendant to the effect that by tests they had found that the process disclosed actually produced a material not mentioned on the face of the patent and said:

"Prior patents are a part of the prior art only by what they disclose upon their face. If they are carried into effect in the industrial world, what is learned from that experience also becomes a part of the prior art. An expert, however, cannot take a process patent, which has never been applied industrially, and work the process in his laboratory, and discover therefrom something which is not disclosed on the face of the patent, and then transfer that experience back to the time of the patent, and make it a part of the prior art for the purpose of defeating a meritorious invention. That would be *ex post facto* law of the most pernicious character."

Railroad Supply Co. v. Hart Steel Co., 222 Fed., 261, 273, C. C. A., 7th Circuit, Baker and Seaman, C. Js., and Geiger, D. J., opinion by Judge Baker:

“So far as human minds are able, judges should exclude from view the disclosure of the patentee, should regard the patentee’s problem as of a time antedating the application, and should, therefore, not too readily accept the *ex post facto* wisdom of the bystander. Prior art structures are to be examined in view of the purposes and laws of such structures. It is not enough that a prior art device approach very near the idea of the patent in suit; it must so clearly disclose the idea that it would be apparent to a mechanic of ordinary intelligence who was not examining the device for the purpose of discovering in it the idea of the patent. For, if he already had that idea, he would not be getting it from the prior art device, but from his own imagination or some other source.”

Tannage Patent Co. v. Donallan, 93 Fed., 811 (C. C., D. Mass.), Colt, C. J. Here an effort was made to prove anticipation of the Schultz process for tanning hides by evidence of defendant’s experts that the process disclosed in a prior patent of Francillon as a dyeing process was in fact a tanning process. Judge Colt said (pp. 820, 821):

“With the Schultz process before him, it may be possible for a skilled expert to tan a skin by following what he believes to be a liberal construction of the Francillon specification, but that is not the question. Francillon is not to be interpreted in the light of and with the knowledge of the Schultz process. The question is assuming the Schultz process did not exist, does Francillon disclose a tanning process, and by following literally his instructions have you solved the problem of a practical and commercial method of chrome tanning? We think the question must be answered in the negative.”

Again, Judge Colt says as to the weight to be attached to experimental operations as evidence of practically useful procedures (p. 815):

“A process carefully conducted by a skilled expert may be adequate to tan skins, and yet be commercially perfectly worthless. Such experimental success should have little or no weight in determining the question of the validity or scope of the Schultz patent.”

Schmertz Wire Glass Co. v. Western Glass Co., 178 Fed., 977, C. C., N. D. Ill., Sanborn, D. J. Here the patent was for a process of making wire glass, and the court gave consideration to alleged anticipation by a British patent to Hyatt. The court says as to this defense (p. 988):

“It may not be difficult, in the present state of the art, to read the Schmertz invention into the Hyatt disclosure; but could it have been done in 1874? No one ever succeeded in doing it, and this is some evidence at least that the description was defective. Was the original conception that of Hyatt or of Schmertz? By using twentieth century magnifying glasses a nineteenth century method has been found efficient which never was so before, and the immensely important point of view of an advanced art is thus unfairly used to discover an original conception never acted on or made anything of, and which never had any practical or beneficial existence.”

THE SUPREME COURT DECISION IN THE HYDE CASE
(242 U. S. 261).

As pointed out in our main brief this decision upholds the patent in suit as good and valid in so far as concerns claims 1, 2, 3, 5, 6, 7 and 12 and invalid as to claims 9, 10 and 11 because not confined to the

results obtained by the invention. This defect in claims 9, 10 and 11 has since been cured by disclaimer made in exact accordance with that decision.

The facts of infringement in the case at bar do not call for or require a determination here of the question whether or not the Supreme Court decision confined the invention and all the claims (claims 9, 10 and 11 by the disclaimer) to the use of a fraction of one per cent. of a suitable mineral-frothing oil on the ore or not. But if this court desires from any point of view to give consideration to that question the following additional discussion of the Supreme Court decision should be considered.

The Supreme Court, in upholding the patent as valid had before it the decision of the District Court in the Hyde case which did not so limit the invention or the claims, the decision of this court in the Hyde case which seems to have assumed that limitation without discussion, and the decision of the District Court in the Miami case which (agreeing with this court in that regard) assumed that limitation without discussion. The limitation of which we speak is an arbitrary arithmetical limitation to a fraction of one per cent. of oil to ore regardless of the varying characteristics of the ore and of the oil and regardless of the varying conditions of heat, acidity and agitation that may be employed. It is not a functional limitation. There is no magic in one per cent. of oil on the ore.

The three decisions that were before the Supreme Court differed among themselves also in another respect which *was* functional and which went to the heart of the matter

both of validity and, one would naturally conclude, of construction also. The decision of the District Court in the Hyde case had held that a new principle of operation had been evoked and a new result obtained. The decision of this court in the Hyde case had held that the principle of operation was old and that the result obtained was old. The decision of the District Court in the Miami case had held with the District Court in the Hyde case that the principle of operation was new and that the result obtained was new.

The Supreme Court also had before it the decision of the House of Lords and the decision of the Privy Council in the two English cases which had held that a new principle of operation had been evoked and a new result obtained. The two English decisions of course considered only the process as such and not any particular patent for the process. The same thing was really true also both in the Hyde case and in the Miami case for in the Hyde case the defendant had used a small fraction of one per cent. of a mineral-frothing oil (.16 per cent. on the ore) and the defendant in the Miami case had done the same thing, and the question of construction, that is to say, of breadth of claim did not arise in either case for the purpose of the issue of infringement but only as it was incidental to and a part of the issue of validity.

The Supreme Court considering the issue of validity and validity alone and finding the fact to be (in agreement with the District Court in the Hyde case and with the District Court in the Miami case and with the House of Lords and with the Privy Council and

in disagreement with this court in the Hyde case) that the patentees had evoked a new principle of operation and obtained a new result, held the patent valid to the extent that its claims were confined to the process that obtained that new result. This holding discriminated between functional and arbitrary confines, adopting the former and rejecting the latter. For the holding was accompanied by the explanation that

“ores vary infinitely, each one presenting its special problem, and it is obviously impossible to specify in a patent the precise treatment which would be most successful and economical in each case”,

and by overthrowing as untenable the claim that the patent is invalid because it prescribes that for different ores preliminary tests must be made

“to determine the amount of oil and the extent of agitation necessary in order to obtain the best results”.

The Supreme Court decision defines with great clearness both the new principle of operation evoked (i. e. the air separation and air lift of the mineral particles) and the new results obtained (i. e., the mineral-carrying air-froth). All the evidence as well as the patent itself showed that this principle was evoked and these results obtained when the quantity of the proper oil used was a fraction of one per cent. on the ore and the decision seizes upon that fact as a convenient way of identifying and referring to the new results. But the decision does not undertake to say that those new results cannot be obtained by the use of more than a fraction of one per cent. of a mineral-froth-forming oil. It was not necessary that the court

should decide that question of fact, nor was it necessary that the court should decide whether as a question of law any of the claims of the patent might cover and include so much, nor the question whether more than one per cent. of a suitable oil might not under certain circumstances be an equivalent in the process for a fraction of one per cent., nor the question whether an oil which did not do the work of the process either to evoke the new principle or to obtain the new result would be the oil or the oily liquid of the claims, nor the question whether a suitable quantity of a suitable oil that would evoke the operation and obtain the result would be any the less the oil or the oily liquid of the claims because intermixed with an oil that would not do the work.

The District Court in the Miami case had declared claim 9 invalid, not because it was not confined to the new results obtained by the patentees but because it was not limited to the use of a fraction of one per cent. of oil on the ore. The Supreme Court held claims 9, 10, and 11 invalid, not because they were not limited to the use of a fraction of one per cent. of oil on the ore, but because they were not confined to the results obtained by the use of a fraction of one per cent. of oil on the ore.

There are two differences between claims 9, 10, and 11 on the one hand, and the other considered claims of the patent on the other hand.

The first difference is this: claims 9, 10 and 11, in speaking of the oil, say, "a small quantity", whereas the other claims say variously "a small proportion

* * * (amounting to a fraction of one per cent. on the ore)”, “a fraction of one per cent.”, etc.

The second difference is that claims 9, 10 and 11 are not in terms limited to a froth formed by, or constituted of, “the oil-coated mineral”, whereas the other claims are.

Judge Bradford seized hold of the first difference, construing “a small quantity” as including more than one per cent., and consequently holding the claim invalid because of his assumption that the invention was arbitrarily limited to the use of a fraction of one per cent. The Supreme Court, however, as we believe, rejected that reasoning, and laid hold of the other difference, construing claims 9, 10 and 11 as broad enough to cover and include froths that were not the mineral-carrying froth of the invention and of the patent—the only result that was new—and therefore held claims 9, 10, and 11 invalid as not confined to the results obtained by the patentees.

This confining of the patent, not to any arbitrary quantity of oil, but to the results first obtained by the patentees, is the most significant thing about the decision in this connection.

The holding of the court is that (p. 8*)

“the patent must be confined to the results obtained by the use of oil within the proportions often described in the testimony and in the claims of the patent as ‘critical proportions’ ‘amounting to a fraction of one per cent. on the ore,’ and, therefore, the decree of this court will be that the patent is valid as to claims Nos. 1, 2, 3, 5, 6, 7 and 12, and that the defendant infringed these claims, but that it is invalid as to claims 9, 10 and 11.”

The clear implication of the language used is that the purpose of the court in declaring claims 9, 10 and 11 invalid was *to confine the patent to a process identified, not by the use of oil within the proportions specified, but by the sort and character of results that are exemplified in the case where the amount of oil used is within the proportions specified* (always of course assuming the presence of ore, water, an oil that will produce those results, and agitation).

Obviously the court did not say that the patent was to be sustained as a patent for a result. It merely asserted the necessity of a limitation in all valid claims to the result that is obtained by ore, water, a suitable oil and agitation with the oil in the proportion of a fraction of one per cent. on the ore, viz., the described mineral-carrying froth. It found such a limitation in all claims considered except claims 9, 10 and 11, and therefore held all considered claims valid except 9, 10 and 11.

In claims 9, 10 and 11 there is no statement that "the oil-coated mineral matter forms a froth", as in claims 1, 2 and 3 or that "the oleic acid has been brought into efficient contact with the mineral and has formed a froth therewith", as in claims 5, 6 and 7, or "to cause the oil-coated mineral to form a froth" as in claim 12, but only "agitating the mixture to form a froth," without any statement that the mineral is to form the froth. Thus "the resulting froth concentrate" of air-bubbles and mineral was not specified in these claims and they were not confined "to the results

*The references in this brief to the Supreme Court decision in the Hyde suit will be to the pages of the pamphlet opinion as published by the Supreme Court.

obtained'' which the Supreme Court repeatedly says characterize the invention.

The reasoning by which, and the circumstances under which, the court reached its conclusion confirm this interpretation of the meaning of that conclusion.

The court, having to deal with, and decide, the question whether invention was involved or required, proceeds by a comparison of the prior art processes with the process of the patent in suit, and by a definition of the latter as contrasted with the former.

Speaking of the process of the patent in suit, the court says (p. 3):

''it differs *so essentially* from all prior processes in its character, in its simplicity of operation and in the resulting concentrate, that we are persuaded that it constitutes a new and patentable discovery.''

Again (p. 5) it quotes as not an overstatement of the facts:

''The present invention differs *essentially* from all previous results. It is true that oil is one of the substances used, but it is used in quantities much smaller than was ever heard of, and it *produces a result never obtained before.*''

And again (pp. 5, 6), it says:

''this advance on the prior art and *the resulting froth concentrate so different from the product of other processes* make of it a patentable discovery as new and original as it has proved useful and economical.''

The court dismisses the Cattermole metal sinking process as belonging to a different class. Of the metal floating class it dismisses Froment as little more than

a laboratory experiment that “has never proved of value in practice”; it dismisses Kirby as involving the use of an amount of oil which “was prohibitive in cost”. It describes the prior art processes of the metal floating class (p. 2) as depending for their usefulness

“on the oil used being sufficient to collect and hold in mechanical suspension the small particles of metal and metalliferous compounds and by its buoyancy to carry them to the surface of the mixture of ore, water and oil.”

and says that in such prior art processes (p. 5)

“the lifting force, which separates the metallic particles of the pulp from the other substances of it, is * * * to be found principally in the buoyancy of the oil used.”

and it describes (p. 2) all of such prior art processes involving ore and water and oil as

“Variously treating the mass—‘the pulp’—thus formed so as to separate the oil, when it becomes impregnated or loaded with the metal and metal bearing particles, from the valueless gangue.”

Thus the Supreme Court points out and emphasizes the *oil-lift* and the *oil-float* of all such prior art processes.

In contrast it describes (p. 5) the process of the patent in suit as one in which *the lifting force*

“is to be found, chiefly, in the buoyancy of the air bubbles introduced into the mixture.”

And the court records (p. 6) its full agreement with the House of Lords decision, quoting Lord Shaw there to the effect that the patentees of the patent in suit

“are engaged upon a new method of separation. Instead of relying upon the lesser specific gravity of oil in bulk,

they rely upon the production of a froth by means of an agitation which not only assists the process of the minute quantities of oil reaching the minute particles of metal, but forms a multitude of air cells, the buoyancy of which air cells, forming around single particles of the metal, floats them to the surface of the liquid."

And quoting Lord Atkinson there to the effect that

"the lifting force is found not in the natural buoyancy of the mass of added oil, but in the buoyancy of air bubbles, which, introduced into the mixture by the more or less violent agitation of it, envelop or become attached to the thinly oiled metallic particles, and raise them to the surface. * * *."

The Supreme Court twice describes the new results of the process in suit as follows (p. 4):

"This froth, on collection, was found to consist of air bubbles modified by the presence of the minute amount of oil used and holding in mechanical suspension between 70% and 80% of the total mineral content of the mass treated."

And again (p. 3):

"a froth, peculiarly coherent and persistent in character, which is composed of air bubbles with only a trace of oil in them, which carry in mechanical suspension a very high percentage of the metal and metalliferous particles of ore which were contained in the mass of crushed ore subjected to treatment."

Thus the Supreme Court points out and emphasizes the *air-lift* of the mineral particles and the *air-froth* as holding them in the process in suit.

And in the above two descriptions of the new results—the new froth concentrate—it is to be noted that the oil whose presence is spoken of in the first case and characterized as minute, is *the oil that has acted to*

modify the air bubbles. And in the second case this idea is even more explicitly set out where the froth is said to be composed of air bubbles “with only a trace of oil *in them.*” It is the clear implication that the oil whose amount is to be minute, the oil that is to exist only as a trace, is the oil actually found in the air bubbles of the froth, acting by its presence there to modify those air bubbles and so to make them “peculiarly coherent and persistent in character.” Other oil is wasted. That is the oil that does the work—the work of the process.

Further light is thrown on the Supreme Court decision in regard to its confining of the patent to the results obtained, etc., when it is noted, as we have pointed out in the main brief, that the Supreme Court seemed to have had particularly in mind toward the end of the opinion the Cattermole “Metal Sinking Process” and the results it obtained as the contrast to the patentees’ results. Thus the court points out (p. 4) that the experimenters were working on the Cattermole process having the special purpose in mind at the time to trace the effect *on the results* of a reduction to the vanishing point in the quantity of oil used, and that the discovery in suit was made in the course of that investigation; that the patentees discovered that the granulation, on which the Cattermole process depended, practically ceased when the oleic acid (oil) had been reduced to about five-tenths of one per cent. on the ore, and that as the amount of oleic acid was further reduced a new phenomenon, a new result supervened, a “float froth”

which carried the metal upward in the pulp instead of downward as in Cattermole. This reduction in the amount of oil used in the Cattermole granulation process brought that factor as such down close to the patentees' amount, so that the final step that the patentees took, viewed merely as a reduction in oil, was not a long one, but that step reversed the operation, carried the metal to the top instead of sinking it to the bottom, evoked an air bubble separation and lift of the mineral particles in place of a sinking by reason of granulation, utilizing to that end the mineral-froth-forming characteristic of oil instead of the stickiness of oil, and obtaining as the final effect or product or result of the process a floating froth constituted of air bubbles modified by the presence of a minute amount of oil in them and carrying a large percentage of the mineral content of the ore, instead of sinking granules composed of oil-coated mineral particles agglomerated by the physical stickiness of the oil present on the particles in sufficient quantity to develop that characteristic.

So regarded, the Supreme Court holding that the patent must be confined to the results obtained by the use of oil in that way and to that end becomes luminously clear and bases the invention and the patent upon the bedrock of that new characteristic of oil that is utilized, that new power of air bubbles that is evoked, that new mineral-carrying air-froth phenomenon that results. And especially is this confirmed by the concurrent holding that the direction of the patent that a simple preliminary test must be made with each

new oil and ore to determine both suitability and quantity is sufficient.

If this is the correct interpretation and understanding of the Supreme Court decision, then claims 9, 10 and 11 were held invalid because not expressly confined to a process that would evoke this principle of operation and obtain these results. The disclaimer of March 28, 1917, confines the patent in so far as concerns claims 9, 10 and 11 to a process that will obtain these results, and this it does by disclaiming all excess over and above that subject matter, and claims 9, 10 and 11 are thereby made valid under the Supreme Court decision, just as the other claims are valid.

The arguments submitted to the Supreme Court in support of claims 9, 10 and 11 asked the Supreme Court to impose by construction upon these broadest claims just the limitation and confinement which the Supreme Court said in its opinion must be imposed upon the patent. The only difference between what counsel requested and what the Supreme Court decreed was that the court did not impose this limitation *by construction*, and therefore held the broadest claims to be invalid. But in its statement of the confinement to be imposed upon the patent the Supreme Court carefully *avoided a limitation to the use of a fraction of one per cent. of oil* and stated the limitation to be *to the effects or results obtained* as we had argued should be done.

Parts of our argument in the Supreme Court are printed in appellant's supplemental brief entitled "Plaintiffs' Limitations, etc." At page 152 a com-

plete statement from page 55 of petitioners-complainants' main brief in the Supreme Court is quoted. On pages 161 and 162 appellant quotes fragments of the argument discussing Judge Bradford's holding that claim 9 was invalid, which quotation, however, omits the most important and significant part of that argument. The full quotation is as follows (Brief for Petitioners-Complainants, Supreme Court Hyde Case, pp. 258-260):

“*Claim 9.* It will be noted that although Judge Bradford finds that the process is dependent on the extreme tenuity of the film of oil on the metallic particles and that the selective action is due to the air bubbles and that the process is ‘an air flotation process,’ he nevertheless limits the breadth of the claims to the carrying on of the procedure with the employment *in the pulp* of a fraction of one per cent. of oil on the weight of the ore. The essence of the invention, as he points out above, is that the metal particles shall be coated with a film ‘so thin as to be imperceptible to the senses’. It is conceivable that this may happen with a larger proportion of oil in the mixture of oil, water and ore than a fraction of one per cent. of the ore, as in the examples above stated in this brief where claim 9 of the patent in suit is considered (*supra*, p. 55), as where a peculiar gangue might uselessly absorb within its pores a portion of the oil, or where the oil or mixture of oils might have unusual characteristics. For example two oils might be used, one of which would coat the mineral with an attenuated film imperceptible to the senses such as the process requires and effect the result of the process, and the other conceivably perform some other useful function, or be wholly useless and neutral and be used merely to justify the statement that in the aggregate more than a fraction of one per cent. of oil had been added to the mixture. It is against such possibilities, any of which might well arise within the life of the patent in the efforts of infringers to use the invention and avoid the wording of the claims, that the patentees are entitled to claims 9, 10 and 11,

and we contend that in this respect (though in this respect only) Judge Bradford erroneously applied the law to the facts of the case. His discussion of claim 9 presents his views on this question.

Judge Bradford says in substance that claims 1 and 12 'are definite, specifying and limiting the amount of oil to be used,' whereas claim 9 in specifying 'a small quantity of oil' is 'so indefinite as to render the claim void'; this conclusion being based on the assumption that if claim 9, like claims 1 and 12 be by construction 'so limited as to be restricted to the use of oil, the amount being only a fraction of one per cent. on the ore, that claim is in substance * * * the same as claim 1.' Apparently Judge Bradford would by construction have so limited claim 9 had it been the only claim in the patent.

Claim 9, we submit (as well as claims 10 and 11, where the same language is employed), should be construed to save them rather than to destroy them (*ut res magis valeat quam pereat*. *Corning v. Burden*, 15 How. 269), in spite of the presence of other claims. Limiting words (as of degree) in a claim should be construed in the light of the disclosure made in the specification and in the light of the real invention (*Carnegie Steel Co. v. Cambria Iron Co.*, 185 U. S. 403, 432. *Robinson on Patents*, Vol. II, p. 507, Sec. 751). So construed, claims 9, 10 and 11 would be limited to that small quantity of oil which is described in the specification and which would in use develop the operation and effect described and would embody the invention. To interpret the term 'small' in these claims loosely enough and broadly enough to bring in and cover and include processes of the prior art which do not involve the real invention, would be contrary to established canons of interpretation repeatedly laid down and applied by this court. Similarly to hold that the word 'small' in this connection is so indefinite that the claims in question are void, would be contrary to established canons of interpretation repeatedly stated and applied by this court. 'Small' in this connection means on a scale on which everything in the prior art was large, small in the sense in which the proportions

set out in the specification are small, small in a sense that will in fact produce the operations and effects described.

Whether or not the phrase 'a small quantity of oil', which is found in claims 9, 10 and 11, would in a proper case be given a slightly broader interpretation than the phrase 'a fraction of one per cent. of oil on the ore' found in other claims, is a question that does not arise in the case at bar, for defendant in the case at bar employed an amount of oil that was at once 'a small quantity of oil' and at the same time 'a fraction of one per cent. of oil on the ore'. Such a question is really a question of construction and scope of claims that does not arise here and is not material here, although it may arise and become material on some future question of infringement—but the question need not be prejudged here (*Carnegie Steel Co. v. Cambria Iron Co.*, *supra*). The claims in question would not necessarily be identical with claims 1 and 12, as Judge Bradford seemed to think. That again would be a question of construction which does not arise here. Claims 9, 10 and 11 are capable of a construction which distinguishes them from the prior art and which is limited to the real invention and which is infringed by defendant's process. They should therefore be sustained, leaving to future litigation possible refinements of distinction in scope between them and other claims if future developments of the art make such distinctions material or important. No harm can be done to any one by that course. Unknown harm might be done to petitioner by the opposite course."

The circumstances under which the Supreme Court decision was made confirm the understanding of it that we have presented.

Thus the Supreme Court had before it the opinion of the District Court in the Hyde case (207 Fed. 956), wherein the claims of the patent in suit are not construed or limited in the matter of quantity of oil permitted and required in the process, but on the con-

trary the language in that regard is general, and the finding of patentable invention is based upon the finding of fact that a new result in kind had been produced by the patentees. Thus that opinion says (p. 957):

“The claims are general and particular, all calling for oil and agitation to produce a froth, some defining a range of quantities of oily substance, some likewise of acid, &c.”

Again, in comparing Froment (as most relied upon by the defendant) with the process of the patent in suit, the District Court opinion in the Hyde case points out in detail the differences not only in procedure but in result.

For example (p. 959):

“In Froment it would seem that the metallic particles are floated like the basket of a balloon, while in this, like the very envelope of a balloon.”

Again, the opinion quotes from Dr. Liebmann’s statement, later adopted by the Supreme Court, that in the process in suit “was produced a result that was never obtained before.”

Again, the opinion, comparing Froment’s process and that in suit says (p. 960):

“They are different in ingredients, function of some thereof, combination, manipulation, principle and result. Their points of resemblance only serve to accentuate their difference.”

And generally summing up, the opinion says (p. 961):

“The process in suit is so clearly new that no exhaustive discussion of facts, cases, or law is necessary to distin-

guish it from other processes or to demonstrate its novelty. * * *

To whatever extent the patentees drew from the prior art, as they rightfully could, they took the last and successful step."

Clearly here the fact that a radically new result had been obtained was the basis of the decision, not a mere economy in oil, and there was no effort to prejudge a question that did not there arise, i. e., whether the claims of the patent were to be limited to a foot-rule measurement of oil quantity.

The Supreme Court also had before it for review the opinion of this court in the Hyde case (214 Fed. 100). According to that opinion the pivotal discovery lay in the use of oil in a quantity less than one per cent. The assumption was that the patent and all its claims were limited to the use of that particular quantity of oil. The finding of fact was that in the prior art the same identical result had been obtained in the way of froth concentrate and ore concentration and with equal efficiency; that the patentees' discovery had been merely that a small fraction of one per cent. of oil was sufficient to produce the old result and that that discovery was not invention. This court found that the only material difference between the prior art and the process in suit consisted in the matter of the quantity of oil used.

Thus the opinion of this court says (214 Fed. 102):

"That which is presented as new in the patent, and as the pivotal discovery on which its validity depends, is the formation of a froth or scum containing the metal-liferous matter produced by agitation of the pulverized

ore in water, by the action of oil in a quantity less than 1 per cent. of the quantity of ore treated."

Again (p. 104):

"When the claims and the description of the process of the appellees' patent are compared with the patents of the prior art, it will be seen that the only material difference is in the smaller quantity of oil which the appellees use."

Again (p. 105):

"The fact that the appellees use a smaller quantity of oil than was used in the prior art is not of itself, and it is not claimed by them to be, sufficient to distinguish their process so as to render it patentable. To discover that the desired result may be accomplished with the use of a fraction of 1 per cent. of oil when formerly a much larger quantity of oil had been used, and had been deemed necessary, is not an invention or discovery within the meaning of the patent laws. It is a difference of degree and not of kind."

Again (p. 106):

"The contention is made, however, that if, indeed, the prior patents disclose froth processes, the scum which the appellees' process causes to rise to the surface of the water is so different from the froth or scum which arises under the prior art that it is a new result and is not anticipated by anything in the prior art. * * * The evidence in the case, together with the illustration thereof afforded by demonstrations of the various processes which were made in the aid of the argument before this court, convince us that the froth in all these processes is the same, with the exception that there is less oil (as there must necessarily be) in the appellees' froth than in the others. The froths are all similar in appearance; they all rise to the surface after the same amount of agitation; they all gather with equal efficiency the same quantity of metal; and all may be removed from the surface in the same way."

Again (p. 109):

“The patentees of the appellees’ patent made a valuable contribution to the art in discovering the smallest quantity of oil which would produce the desired result. In doing so, they pursued the course which all skillful metallurgists would be expected to pursue. They made a series of experiments to determine how small a quantity of oil could be used successfully. * * * Their discovery that a small fraction of 1 per cent. of oil is sufficient to produce flotation of the metalliferous matter cannot, as we have seen, be made by itself or in a combination the subject of a patent. The appellees cannot take from others the right to use oil economically.”

Manifestly the reduction in the quantity of oil used to a microscopic amount was fundamental to, and the sole content of, this conception of the process in suit. In fact, according to this conception, that was all there was to the process. And naturally we find the opinion assuming throughout that the reduction in the quantity of oil must be to a fraction, or perhaps even to “a small fraction of 1 per cent. of oil” to ore.

Judge Bradford, in his opinion in the Miami case (237 Fed. 609) (which was filed on September 29, 1916, and copies of which were handed to the Justices of the Supreme Court at the argument of the Hyde case) assumes throughout (yielding so much to the decision of this court) that the patentability of the process of the patent in suit resides in the use of a fraction of one per cent. of oil on the ore, and that the process only proceeds when a fraction of one per cent. of oil is used.

Thus, in dealing with claim 9, Judge Bradford says (p. 630):

“The patentability of the process of the first patent in suit resides in the use of oil in the extremely minute proportion disclosed in the descriptive portion of the patent to effect separation of froth with its metallic particles from the remainder of the mixture by flotation. The amount there disclosed is not in excess of ‘a fraction of one per cent. on the ore’ and may be only one-tenth of one per cent. on the ore, or even less.”

Judge Bradford did, however, give some consideration to an argument presented by plaintiffs’ counsel as follows:

“It is suggested by one of the plaintiff’s counsel in his consideration of claim 9, that one for the purpose of securing immunity from the consequences of infringement might use an oil useful in the process, and add to it an oil not useful as applied to his particular ore, and, on being sued for infringement contend, ‘I am using 1.1% of oil. I do not infringe. I am using more than a fraction of 1% of oil’. But the existence of this possibility does not, I think, warrant such a construction of claim 9 as is urged; for the disclosure of the patent does not extend to the use of 1.1% of oil, but is limited to a fraction of 1%. If it be assumed, however, that the claims in suit contemplate and require the use of efficient, as distinguished from inefficient, oil, and if in the case suggested an inoperative oil should be used by way of addition to the efficient oil so contemplated and required it might be a question, upon which, however, no opinion is here expressed, whether the addition of the inoperative oil to the efficient oil could be treated as an increment to the amount of oil so contemplated and required, operating as a shield to protect the wrongdoer. But this question would arise in a suit based upon claim 1 or 12, as well as in a suit based upon claim 9, were it proper by construction, in order to save it, to limit ‘a small quantity of oil’ to a quantity of oil amounting only to a fraction of one per cent. on the ore, and therefore fails to require or justify the suggested limitation of claim 9, without which it must fall” (pp. 630, 631).

As is evident from the above, no question of infringement was presented to Judge Bradford which called for or required a construction of any of the claims as applicable to the use of one per cent. or more of oil. Judge Bradford says that the defendant in its operations had "used the minute proportion of oil mentioned in the first patent in suit" (p. 631), that patent being the patent here in suit.

And nothing in the prior art required so rigid a limitation.

It is to be noted that when Judge Bradford filed his opinion, the decision of this court in the Hyde case was the latest and the most authoritative and an outstanding decision as yet unreversed, and he apparently adopted from that decision the idea it everywhere assumes, namely, that the invention itself and the disclosure of it in the patent in suit consisted in, and must be limited to, the use of a fraction of one per cent. of oil. He differed from this court in his conclusion that that process involved and required invention, agreeing with the District Court in the Hyde case in that matter and for the same reason, namely, that a *new result* had, as he found, in fact been obtained. He followed the District Court in the Hyde case in this latter finding and he followed this court in the limitation of the invention to the use of a fraction of one per cent. of oil on the ore. He did not find in claim 9 a limitation to a fraction of one per cent. of oil or a definite identification of the process by the new result, and he therefore held that claim 9 was indefinite and invalid.

The Supreme Court had these three decisions before it, two for review. It agreed with the two District Courts in finding that a new result had in fact been obtained, reversing the finding of this court in that regard. But while agreeing with the District Court in the Miami case in holding claim 9 invalid, it did so for the sole reason that the patent must be confined

“to the results obtained” (p. 5)

by the use of oil within the proportions specified in claims 1, 2, 3, 5, 6, 7 and 12.

Thus, by the decision of the Supreme Court, “the question of infringement *was acutely enlarged*,” to quote the language of the Third Circuit Court of Appeals in its decision affirming Judge Bradford, page 11. The reasoning of Judge Bradford’s decision made the test of infringement arbitrarily the use of oil in “a fraction of one per cent. on the ore.” The Supreme Court, less arbitrarily but more logically and more liberally and acutely enlarging the question of infringement, made the test of infringement “the *results obtained* by the use of oil” “amounting to a fraction of one per cent. on the ore.” This was more logical because, “the results obtained” by the patentees having been found to be absolutely new, *the obtaining of those same results* by an alleged infringer *would be conclusive evidence that at least he was not using any process of the prior art. It was more liberal because it made the test functional rather than arbitrary.*

The Supreme Court decision in the matter under discussion was significantly and acutely broader and

more liberal than the decision of the District Court in the Miami case.

The idea that the patent must in any event be limited to a procedure in which a fraction of one per cent. oil to ore is used was, as we have said, first expressed judicially in the opinion of this court in the Hyde case following the ingenious argument of defendant-appellant's counsel there that the sole novelty disclosed in the patent was the use of less than one per cent. of oil. That argument was false. The prior art did not disclose a process wherein there was an air-bubble separation and lift of the mineral particles up through and out of the pulp resulting in an air-bubble froth holding the particles in mechanical suspension above the pulp, as the Supreme Court has held. But the defendant in that case used the identical oil, oleic acid, of the example of the patent, and within the recommended proportions of that example, .02% to .5% on the ore. The defendant in fact used oleic acid in the proportion of .16% on the ore (Vol. 2, p. 166). No question of construction could possibly have arisen in that case calling for the consideration of the applicability of any of the claims to a procedure involving the use of more than a small fraction of one per cent. on the ore. The error that the patent must be limited to a process employing a fraction of one per cent. of oil was perhaps contributed to by the circumstances connected with the making of the invention and the evidence as to the appellees' practice, in both of which it appeared that the best results were obtained when the quantity of oil used was

a very small fraction of one per cent., and perhaps too from the particular example of oil proportion given in the specification of the patent. The idea was adopted, perhaps as a measure of caution, by Judge Bradford in the decision in the Miami case, although again the limitation of the patent in that direction did not arise, for the defendant there, like the defendant in the Hyde case, had used a very small fraction of one per cent. Further, Judge Bradford suggested that a distinction might be made between

“the use of efficient, as distinguished from inefficient oil”
(237 Fed. 631),

but as to this he expressed no opinion. He held claim 9 to be invalid, and *the idea of its invalidity originated with him*. It was not suggested by counsel for the defendant there either in evidence or in argument.

The Supreme Court, in setting out “the process of the patent in suit, *as described and practiced*” (p. 3) says that it

“consists in the use of an amount of oil which is ‘critical’, and minute as compared with the amount used in prior processes ‘amounting to a fraction of one per cent. on the ore’, and in so impregnating with air the mass of ore and water used, &c.”

but when it comes to the question of *the interpretation or scope of the patent* in that regard, it says (p. 8):

“the patent must be confined to *the results obtained by*”
such use of oil.

This explicitly distinguishes between description and practice on the one hand, and the confining of the pat-

ent, that is to say, interpretation of the claims of the patent as a matter of law, on the other hand.

The Circuit Court of Appeals for the Third Circuit, in the Miami case, as we shall show, points out that even in the original experiments of the patentees the new results were to some extent obtained even when more than one per cent. of oil was used, and that court follows the Supreme Court in confining the patent to (and by necessary implication expanding it out to) "the results obtained," namely, the novel results pointed out by both courts and by the patent.

So the authoritative decisions in so far as they relate to the confining or limitation of the claims of the patent in suit, do not limit it to the use of a fraction of one per cent. of oil to ore, but to the specified process characterized and recognized and identified by its novel results, which novel results are set out both by the Supreme Court and by the Circuit Court of Appeals for the Third Circuit.

The opinion of the District Court in the case at bar is fully considered elsewhere in this brief under a separate heading (*supra*, p. 250 et seq.). In it the disclosures of the patent and of the opinion of the Supreme Court are considered at length, and the conclusion is stated that neither the patent nor the decision says that the process depends upon less than one per cent. of oil or is inoperative with one per cent. or more of oil, and the further view is expressed that the Supreme Court in its words of limitation employed the word "use" in "the ordinary sense of *beneficial service*."

It may be added that there is no present knowledge of the use in beneficial service of one per cent. or more of oil in carrying out the process of the patent in suit.

It is submitted that the above discussion, in so far as it considers the limitations imposed by the Supreme Court decision, is not essential to the question of infringement presented in the case at bar by the recent practice of the appellant since the first of the year, because it is a fact that the quantity of mineral-froth-forming oil that is used is a small fraction of one per cent., and the excess oil that is added is a mask or cover for the real process and has no part in forming the mineral froth, and so is not, in the eyes of the law, the oil of the claims of the patent in suit at all, and is carefully and purposely so selected and so used as not to prevent the proper proceeding of the real process, although, as proved, the results are impaired.

There is another matter which was considered by the court below and is entitled to consideration by this court. It has to do with the matter of agitation—its character and degree. The appellant here employs at a late stage of his process pneumatic agitation—*agitation by air forced into the pulp*—in the final cleaning of its tailings by froth flotation. It is also true, however, that the appellant repeatedly employs at earlier stages of its process, in handling the same pulp, the same identical character of agitation as the appellees employ in practice, and even greater in degree of violence. So also in the Miami case the defendant employed pneumatic agitation in exactly similar apparatus known as Callow cells, preceding it by agi-

tation in other apparatus. In the Miami case the defendant contended that it did not infringe because the agitation that it employed was different in character from, and less in degree than, plaintiff's practice, and that the only invention plaintiff's patentees had made over the art resided in a stated kind and violence of agitation. True defendant there sought also to show that even that kind and violence of agitation was old in the art, but in the alternative it sought to have the court impose upon the patent a limitation to violent mechanical agitation. Indeed, defendant's argument there is exemplified in fruition in the dissenting opinion filed by Judge Buffington which went to the extent of asserting that the patent should not merely be limited to mechanical agitation and mechanical agitation by a Gabbett mixer but even by a particular kind of Gabbett mixer and a particular kind of Gabbett mixer which was not shown in the patent and was in fact never used in the process. Defendant's argument there was that the Supreme Court itself had so defined the invention and limited the patent in the matter of agitation where it said (p. 3):

“and in so impregnating with air the mass of ore and water used, by agitation—‘by beating the air into the mass’—as to cause to rise to the surface of the mass, or pulp, a froth, &c.”

And again (top of p. 5):

“air introduced into the mixture by the agitation which had been resorted to, to mix the oil with the particles of crushed ore, which air, in bubbles, attached itself, &c.”

And again (bottom of p. 5):

“air bubbles introduced into the mixture by an agitation greater than and different from that which had been resorted to before.”

We pointed out in reply in the Miami case that all of this was found in the part of the opinion that dealt with the process “as described and practiced” (p. 3) whereas in the concluding part of the opinion, where the only statement as to what “the patent must be confined to” is made—the only part of the opinion having to do in any sense with construction or limitation—no reference is made to this matter of agitation, either its character or its degree. This view has been adopted by the Circuit Court of Appeals for the Third Circuit, in the Miami case, where it is said of the defendant’s argument in this regard (p. 12 of that opinion*):

“defendant misinterprets words of description as words of limitation”;

and where, quoting from the Supreme Court the first of the three statements quoted above, the Third Circuit Court of Appeals continues (pp. 12, 13):

“By this expression the defendant maintains that the Supreme Court did not merely repeat testimony describing and showing how the process was practiced, but used the words as their own, and thereby interpreted the patent and limited its scope to the introduction of air into the pulp ‘by beating the air’ into the pulp by the specific mechanical means illustratively shown by the drawings of the patent. We do not so interpret this expression.

*The references in this brief to the opinion of the Circuit Court of Appeals of the Third Circuit will be to a copy thereof as printed by us and handed to this court.

In the first place the patent nowhere uses the words 'by beating the air into the mass'. Therefore these words as quoted by the Supreme Court, were not quoted from the patent, but were taken from the testimony of a witness who used them in describing the process as discovered and developed by the patentees. This being so, we do not think these words, as used by the Supreme Court in describing the process, can be construed as a limitation upon the process.

It further appears that the Supreme Court, in distinguishing the process of the patent from processes of other patents relied on as anticipations, found that the lifting force which separates metallic particles of the pulp from other substances resides chiefly 'in the buoyancy of the air bubbles introduced into the mixture *by an agitation greater than and different from that which had been resorted to before*'. By this expression the defendant insists that the court explicitly limited the patent to agitation caused by mechanical means, thereby excluding from its scope such agitation by pneumatic means as was used in part in the defendant's practice. As this expression is susceptible of an entirely different meaning, presently to be considered, we find nothing said by the Supreme Court, which indicates that it limited the agitation of the patent to agitation by mechanical means'' (italics in original).

The Third Circuit Court of Appeals then quotes the concluding part of the opinion, where the statement is made as to what the patent must be confined to, and comments upon it as follows (p. 14):

"We are inclined to the opinion that by this expression the court intended a limitation only upon that one feature of the patent to which the expression was addressed. The District Court had held valid certain claims in which the proportion of oil was described simply as 'a small quantity', and the Supreme Court, in reversing that finding and holding those claims invalid, used the quoted words of limitation in confining the patent to the *results obtained* by the use of oil in the critical proportions of less than 1%.

From this recital of the litigation as to the invention of the first patent it appears that in construing the claims of the patent we are greatly aided by the opinion of the Supreme Court in being told with authoritative finality that the process involves invention and in being shown in which of its elements invention resides; but it is equally clear that in determining the breadth and scope of the claims, we are without the aid of any adjudication in which their scope has been decided or even considered." (Italics ours.)

The Third Circuit Court of Appeals later on considers the entirely different meaning that the Supreme Court's expression as to agitation is susceptible of.

Certainly the patent in suit cannot be limited to a "beating in" of air into the pulp as contradistinguished from a drawing in or sucking in of air or a forcing in of air; for the apparatus disclosed in the patent in suit (a Gabbett cone mixer without beater arms) will not beat the air in. The Supreme Court must have been speaking of appellees' commercial practice, as it explicitly stated on page 3 of its opinion. Appellees' practice was then and is largely now to employ a propeller form of beater agitator, but that practice did not begin until 1907 or 1908 (Chapman, Vol. 2, pp. 248, 249, Q27). Such a beater agitator is shown at "B" in the drawings of appellees' soluble frothing agent patent No. 962,678, dated June 28, 1910 (Vol. 9, p. 5274).

The Gabbett cone mixer shown at B in Fig. 1 of the drawings of the patent in suit introduces air into the pulp, not by beating it in, but by drawing or sucking it in. It does not even contain the inner ribs on the Gabbett cone shown in the drawings of the Gab-

bett patent (see Judge Buffington's dissenting opinion 244 Fed. 779), as appears from Complainants' Exhibit cone mixer testified to by Mr. Higgins as a reproduction of the cone mixer used by him in the crucial experiments in 1905 at the birth of the invention (Vol. 3, pp. 925, 926, Qs23, 24). Judge Buffington apparently overlooked this exhibit, which was in evidence before him as well as the drawings of the patent in suit.

It is clear, therefore, that the introduction of air by drawing or sucking it into the pulp must be within the process.

The apparatus of Fig. 2 of the patent in suit which is described on page 2, line 103, to page 3, line 34 (and described there, as appellant's expert Dr. Byrnes admitted, as a complete modified procedure commencing with the introduction of the ore into the water and ending with the separation of the froth, and described earlier in the specification as an alternative method for the retreatment of the tailings of the second and third spitzkasten of the apparatus of Fig. 1) introduces the air by forcing it into the pulp by a pressure of 50 to 100 pounds per square inch, sufficient to cause the air to be dissolved to a considerable extent in the pulp, the aeration and agitation being effected by the sudden relief of such pressure so that the air introduced by the pressure forms bubbles throughout the body of the pulp and sweeps to the surface,

“all metalliferous matter in the form of a froth” (Spec., p. 2, line 115).

“a coherent scum or froth” (Spec., p. 3, line 29).

The patent in suit also discloses a method of distributing oil through an ore pulp and selectively coating the mineral particles with oil, which method requires only gentle agitation (*infra*, p. 35).

It is clear again, therefore, that the process cannot be limited to mechanical agitation or so as to exclude the introduction of air by pressure from without.

Indeed in the very nature of things it is immaterial how the air is introduced into the pulp, so that it be effectively introduced, and introduced into pulp containing a frothing agent, and so that mineral-holding air-froth be in fact thereby produced. The only rational view to take of this matter is that set out in appellees' soluble frothing agent patent No. 962,678, Defendant's Exhibit 218, where it is said (Vol. 9, p. 5275, lines 23-29):

"a gas is liberated in, generated in, or effectively introduced into the mixture and the ore particles come in contact with the gas and the result is that metallic sulphide particles float to the surface in the form of a froth or scum."

Again the rational view is also well presented by Professors Beach and Taggart, two of appellant's expert witnesses in the present suit, who studied the process of the patent in suit after it had attracted wide attention in the United States, and evolved a theory which Prof. Beach denominates the Beach-Taggart explanation of flotation. Their paper, published in *Metallurgical and Chemical Engineering*, a mining periodical, of November 1, 1916, after having been presented before the American Institute of Mining

Engineers in September, 1916 (Vol. 6, p. 2996, XQs126-128), gives consideration to the pneumatic cell or air basket type of agitation and aeration and says:

“The principles involved in this method are the same as explained in the agitation-froth process. The only difference is in the method of introducing air. The result of this difference is that the bubbles in the pulp are much larger than in the agitation-froth method; they arrive at the surface less heavily loaded in proportion to their weight. The bubble films are therefore less viscous and the froth less persistent” (Vol. 6, p. 2999, XQs136, 137; p. 3088, XQs 112, 113).

What they refer to as the agitation-froth process as repeatedly appears, is the carrying on of the process in suit with the type of agitation and aeration wherein air is introduced from above by agitation in one vessel and the froth is separated in another vessel.

The fact is that the whole discussion and controversy as to infringement in the Miami case had no basis of fact either in the nature of the invention or in the relation of the prior art to that invention or in the language of the specification or of the claims of the patent in suit. It was based wholly upon a misinterpretation of the language of the Supreme Court in that regard. The Supreme Court was at that point describing a practice, not construing a patent. And in describing that practice its language must be construed in accordance with the actual facts, not contrary to those facts. It is the actual fact that the degree of agitation employed by the patentees in and by the use of the Gabbett mixer at the birth of the invention in suit was identically the same in every respect with the agitation that they had been employ-

ing for the Cattermole process. The same machine was used, the same speed of rotation was used, the pulp was manipulated in identically the same way. There was no doubt of this fact on the face of the Hyde record, as it went up in somewhat abbreviated form to this court and the Supreme Court, but even if that were not so the actual fact has been proved in this case (Higgins, Vol. 8, pp. 4533-4535, Qs. 351-359). Not only was the same identical Gabbett mixer in use in the Spring of 1905 both for the Cattermole process and for the process of the patent in suit, and rotating at identically the same speed, but this was repeated in court at the trial of the present suit in several demonstrations, all in the Gabbett and at about 850 or 900 revolutions per minute. First, the Cattermole process was carried on from beginning to end (Vol. 8, pp. 4526-4529 Qs. 314-328) with a recovery in granules of 93.6% (Vol. 9, p. 5562). Here the amount of oil was rather large because of the fine grinding of the ore and so as to produce large granules, about 15% on the metalliferous mineral and 5% on the ore. Thereafter Mr. Higgins carried on the process of the patent in suit with one-tenth of one per cent. of oleic acid (Vol. 8, pp. 4747, 4748, Qs. 84-86). This produced an excellent mineral froth. Then 3.6% of the same oil was added, making the total oil 3.7% (p. 4749, Q93). The operation was exactly repeated and the result was that the froth was wholly destroyed and granules were formed (Qs.94-96). In order to show that high speed was not injurious to Cattermole granules Mr. Higgins then ran the machine at a speed

of over 1500 revolutions per minute (Q99). The result of the operation was the formation of very good granules, including practically the whole of the mineral (Q100).

The Supreme Court speaks of the Gabbett mixer being speeded up to "from 1000 to 1100 revolutions per minute," putting it in quotation marks. The quotation is taken from the May 3, 1905, report of Sulman and Picard, found at page 450 of the Supreme Court Record, the language quoted being found at the bottom of page 452 and top of page 453 (see Vol. 3, p. 1117, lines 6 and 7 from bottom). Messrs. Sulman and Picard were there starting in to describe, not the details of the original discovery, but the first apparatus in which the process was adapted for *continuous operation*. That is to say, the process as originally discovered and tried out was an intermittent operation. This intermittent operation is described in the Supreme Court Record on pages 451 and 452, down to the last paragraph (see Vol. 3, pp. 1113-1117). Then it is said

"A very large number of experiments was carried out on this method, and the process was then tried as a *continuous one*,"

and all that follows is a description of the apparatus used in that continuous operation. It was then (and not until then) that the Gabbett mixers were speeded up to 1000 to 1100 revolutions per minute. But the invention had been previously made and completely made. We must, therefore, understand the Supreme Court as referring to this speeding up (from about

900 revolutions per minute to 1000 to 1100 revolutions per minute) as occurring "as the experiments proceeded," as indeed the court expressly says, and not as vital or essential to the process or as a limitation of the patent, which was what the defendant argued in the Miami case.

We understand the Supreme Court, in describing the petitioners-plaintiffs' practice in the matter of agitation, as simply distinguishing that agitation in character and degree from the agitation of the metal-lifting or "surface flotation" processes of the prior art, for example, from the agitation of Elmore and of Froment and of Kirby, none of which produced, or was intended to produce, an air-lift or an air-froth of the character of the process in suit. We believe that the expressions of the Supreme Court in regard to agitation were really intended to be a pointed criticism of the pretended but false demonstrations of Everson, Kirby and Froment made by the respondent-defendant in open court at the time of the argument, and substantially repeating like false demonstrations made in this court at the argument of the Hyde case. For example, the respondent-defendant's pretended demonstration of Kirby was with 25% of alleged kerosene in a square glass jar with a beater agitator revolving at the rate of 1600 revolutions per minute for thirty seconds. The pretended Froment demonstration, with 3.6% of olive oil, was performed in an identical square glass jar and with an identical beater agitator rotating at the rate of 1600 revolutions per minute for one minute and fifty seconds. The pretended Everson

demonstration, with 17% of alleged kerosene, in an identical square glass jar and with a beater agitator rotating at the rate of 1600 revolutions per minute for 30 seconds. In contrast to this plaintiffs-petitioners demonstrated the real Everson invention with a miner's gold washing pan or batea for separating by vaning in the pan after thorough mixing, as demonstrated in the case at bar (Higgins, Vol. 8, pp. 4473, 4474, Qs57-60) but not described in the Hyde Record (or shown to this court), the fact that it was not in the Hyde Record being stated to the Justices at the time, and their special consent obtained for a demonstration outside the record; also Elmore, with his peculiarly gentle agitation as in the Hyde Record (Vol. 2, p. 288, XQ. 125); also Froment in a test tube shaken by hand, as in the Hyde Record (Vol 3, pp. 891, 892); also Kirby, in the actual Kirby apparatus with the Kirby ore, as in the case at bar, the mixer or stirrer having about 160 revolutions per minute in the mixing tank A and about 30 revolutions per minute in the separating tank B (Vol. 8, p. 4494, Q150 et seq.; 188 r. p. m. in mixing tank and 30 r. p. m. in separating tank, p. 4505, Qs209, 210). Here also the demonstration was outside the Hyde Record, so stated, and with the special consent of the court, and had not been given in this court, but like the Everson was a repetition of what had been done at the Miami trial. The demonstrations of the respondent-defendant in the Supreme Court showed an agitation for Kirby, Froment and Everson which were substantially identical in character and degree with one another and with that of

the patentees' process, which latter was demonstrated by the use of .1% of oil in an identical square glass jar and with an identical beater agitator rotated at 1700 revolutions per minute for seven minutes. In the light of the plaintiffs-petitioners' demonstrations and in spite of the respondent-defendant's demonstrations, as we believe, the Supreme Court found the patentees' agitation "greater than and different from that which had been resorted to before"—not to confine the patent to any one character or degree of agitation that would produce an air-lift and an air-froth as contradistinguished from another degree or character of agitation that would accomplish the same result, but as helping to distinguish from Everson, Froment and Kirby where the purpose was different, where the function and operation were different, where the *results obtained* were different. All of which gives point and meaning to the breadth and scope of the definition that the Supreme Court has given to the invention and to the patent, namely, that the invention is for a raising of the mineral particles through the pulp by an air-bubble lift and the holding and carrying of the mineral particles above the pulp in an air-bubble froth, and that the patent is to be confined to this *operation and result*, but is not to be otherwise confined.

**OPINION OF THIRD CIRCUIT COURT OF APPEALS IN THE
MIAMI CASE.**

This opinion was filed May 24, 1917, the case having been argued on January 30 and 31 and February 1,

2 and 3, 1917. It is reported in 244 Fed. 752, but the references here to the opinion of the court, written by Judge Woolley, will be to the pages in a copy of that opinion handed by us to the court.

At the time of the argument there no disclaimer as to claims 9, 10 and 11 had been filed and accordingly plaintiff's appeal there from the part of the decree below holding claim 9 invalid was abandoned, and that claim was thereby withdrawn from the consideration of the Circuit Court of Appeals (Opinion, p. 4).

This opinion has been to some extent referred to above in the consideration of the decision of the Supreme Court.

As stated above no question of infringement having to do with the amount of oil used arose in the Miami case any more than in the Hyde case, because the defendant used the minute fraction of one per cent. of oil to ore particularly recommended by the patent in the example given in it and the patent was therefore not construed in that regard there. The whole question of infringement there turned on the character and degree of agitation employed by the defendant in that case. Consequently the question as to the quantity of oil involved in the process of the patent and the limitations in that regard, if any, of the claims of the patent was not in issue there and was not discussed there. The Circuit Court of Appeals for the Third Circuit in describing the making of the discovery says (p. 8):

“In experiments with oil in proportions just under the Cattermole proportion nothing resulted. The Catter-

mole concentration was lost and no other concentration was obtained. When in the line of experiments, the proportion of oil to ore was reduced to 1.5% a 'float' appeared. At 1.04% still more 'float' appeared. At .32% the 'float vastly increased'. At .10% the float again 'vastly increased'. It thus developed that in using oil at .10% or even at .05% on the ore, and after violently agitating the pulp from two and one-half to ten minutes, there arose to the surface when the pulp was brought to rest a thick froth or foam of oil-coated air bubbles carrying oil-coated metal particles to the extent of about 90% of the metal content, the foam being sufficiently stable to permit removal and metal recoveries.

This was an entirely new result based upon a phenomenon then unknown and still unexplained. It constituted discovery. It was a discovery that promised what has since been accomplished—a change in the art of oil flotation from laboratory experiments and mill failures to commercial success."

The Circuit Court of Appeals for the Third Circuit gives special attention throughout to that part of the decision of the Supreme Court which deals with the character and degree of agitation involved in the process; nevertheless, on page 12, and again on page 14, it points out that the Supreme Court laid down (p. 12) "the very definite limitation of the patent to *the results obtained* by the use of oil within the described proportions &c." (p. 14), "confining the patent to *the results obtained* by the use of oil in the critical proportions of less than 1%."

It points out also, on page 11:

"It is to be noted and kept in mind that the Supreme Court did not construe the patent or determine its scope, for it had no occasion to do so. In the case before it, infringement was so clear that it had to be found if the patent was valid. The validity of the patent, therefore,

was the only seriously controverted issue before the Supreme Court.”

On pages 14, 15 and 16 it says of the patent here in suit:

“The elements of the patent in which invention is found are oil, air and agitation. These were old in the art. * * * But a finding by the Supreme Court that the invention was not anticipated by the old uses and results of these elements is in effect a finding that these elements as used in the process of the patent perform or develop new uses and functions or produce different results. And such we find to be the fact. * * *

Three new uses of old elements are disclosed by the patent, producing a new result. The first relates to oil.

The affinity of oil for metal was known, and though old, was employed in the invention; but that this affinity in a given condition is greatest when its quantity is relatively least or that the affinity increases with the decrease of oil below a given quantity (less than 1%) is the soul of the discovery and was wholly new. But the discovery did not consist of this alone. * * *

The agitation of the patent does several things, old and new. It mixes the oil with the metal of the ore. This is old. Then by its greater intensity and longer duration it stirs the pulp into a froth, developing at once its own new use as a frothing means and still another new function of oil—that of a frothing agent. Both are new.

But froth is made of air as well as oil. Air in bubbles is used for its old function of assisting or escorting metal particles to the surface. But it is also used for the entirely novel purpose of supplying one of the essential elements of froth, froth being the new result intended.

Thus oil is used for its newly discovered characteristics of greater metal affinity when in minute quantity and for its new function as a frothing agent; air for the new purpose of supplying an element of froth; and agitation for its new purpose of bringing the two together and causing them to co-act and produce the new result of a metal-carrying froth. In other words, in so employ-

ing these old elements for new purposes, the new things which the patentees told the art are that a radical decrease of oil in conjunction with a radical increase of agitation develops to its highest potentiality the known affinity of oil for metal and produces a physical change in the pulp in the form of a froth by which metal recoveries are made possible and commercially profitable. The importance of these disclosures, scientifically and commercially, is manifest."

Thus the Circuit Court of Appeals for the Third Circuit gives emphatic endorsement to the finding of fact that the patentees of the patent in suit have obtained a result never before obtained, and by functions and operations that are novel, and by a process that required invention and is patentable.

The references to a fraction of one per cent. seem to be simply a convenient expression taken from the testimony of witnesses or from the preferred example of the patent or from the prior opinions and were evidently not intended to express a judgment on the question whether or not the disclosures of the patent are so limited or whether or not the claims of the patent as a matter of legal construction should be so limited, for no question in that regard arose there or was discussed or considered.

In so far as the facts in the Miami suit resemble the facts in the case at bar, it is to be noted as above stated that the appellant has recently employed pneumatic cells exactly the same as Callow cells (called air-baskets) for finally cleaning up the tailings in a pulp that has previously been abundantly aerated by

agitation of a high degree of violence, and also has recently employed Janney machines of the mechanical-pneumatic type as the fourth, fifth, sixth and seventh machines in each series of seven so-called pyramid machines. In these Janney mechanical-pneumatic machines the spitzkastens are provided with porous medium false bottoms through which air is discharged into the pulp to assist froth production, the pulp flowing into the spitzkasten directly from the agitating chamber wherein it has been subjected to the intense agitation which characterizes the Janney machine. On the other hand, in all of the other Janney machines of the appellant the agitation in the agitating chamber is solely relied upon to effect the aeration of the pulp and the subsequent froth-flotation in the spitzkasten. Thus the appellant's practice well illustrates, separately and in combination, aeration by agitation and agitation by aeration, each type of machine producing and delivering a mineral froth—carrying on the process of the patent in suit and producing the new results first obtained by the process of the patent in suit.

These examples furnished by the operations of the appellant in the present suit of the use of pneumatic agitation alone in separate Callow machines and of pneumatic agitation combined with mechanical-aerating agitation in Janney pneumatic-mechanical machines, well illustrate the equivalency of mechanical and pneumatic agitation in carrying on the process in suit, and the District Court, with these examples before it and other enlightenment from the present record and prior adjudications, expresses conclusions which well sum up

the essentials of agitation and aeration for the process in suit. The District Court says, after particular consideration of the new scientific evidence (pp. clxxx, clxxxi):

“From these it is gathered that the mere introduction of particles of air into a liquid does not create bubbles, but that they are created by subsequent agitation, *either applied or self-agitation*. Air particles introduced into pure water are incapable of creating bubbles. The reasons are the surface tension of the water and the lack of viscosity to create a sufficient film about the air particle compel the escape of the air particles into the atmosphere and no bubble is formed. Some soaps and oils possess the quality to lessen this surface tension of water and to give or increase this necessary viscosity. Their addition in appropriate quantities of water enables air particles introduced therein to create bubbles. Rather the meeting and co-action of water, oil and air, creates a film composed of all three, and which surrounds the air particle. This film is more viscous than the mass of the water, and rising to the surface, the tension of which (and of the films) has been reduced by the oil, maintains itself as an air bubble. This quality of oil is of first importance in the process.”

Later the District Court says (p. clxxxiii):

“How the air particles are introduced into the pulp is immaterial. For introduced, they are still particles and not bubbles. Agitation subsequent to introduction is vital and alone can convert air particles into water-oil-air bubbles. It is this subsequent agitation that within the claims of the patent agitates ‘the mixture until the oil-coated mineral matter forms into a froth’ or ‘to form a froth’. And it is all one whether this be applied agitation or self-agitation—the agitation set up by the air particles themselves in merely rising through the mass and thereby coming in contact with both water and oil, all co-acting to form bubbles which capture the metal.”

MISINTERPRETATION OF FIGURES IN APPELLANT'S BRIEF.

On page 53 of appellant's brief an effort is made to show by the figures in reports of appellant's operations that very little oil went to waste in the tailings when twenty pounds or more of oil were used per ton of ore. The figures given are of the percentages of oil in the tailings to the tailings themselves. These maximum and minimum figures for regular operations employing one per cent. or more of oil are quite small, .55% to .71%. The corresponding figures for the exhibited operation on April 29, 1917, are given in appellant's brief as .35%, but this is evidently a typographical error, since the figures given in appellant's assay is .67% (Vol. 9, p. 5184). But these figures are altogether deceptive. They only give the oil percentages in these waste products. The question is how much of the oil that was used went to waste in the tailings. This can be easily calculated, since the tonnage of feed and the tonnage of concentrates are given, and the difference between them is the tonnage of the tailings. The percentages of oil in each of these products is also given. These figures show that on February 4-28, when the tailings carried the minimum percentage of oil to tailings, of .55%, they actually carried 41.9% of the oil that had been used, and the oil that they carried was 8.4 lbs. to the ton of feed or ore treated and .42% of the ore treated (i. e., 42 one-hundredths of one per cent. of the ore treated). The oil used was 20.07 lbs. to the ton of ore, 1% of the ore. Of this 20.07 lbs. the tailings carried 8.4 per ton of ore treated.

So also during the period of March 21-31, when the tailings carried the maximum percentage of oil to tailings, .71%, they actually carried 49% (nearly half) of the oil used, and the oil that they carried was 9.2 lbs to the ton of ore treated and .46% of the ore treated.

So also at the exhibited run of April 29, 1917, the oil in the tailings was only .67% of the tailings, but this was 39.2% of the oil used, and the oil carried by the tailings was 10.34 lbs. per ton of ore treated and .52% of the ore treated.

Thus each of these operations was carried on with a very large proportion of the oil useless in the process and wasted in the tailings, and appellant's reports corroborate the testimony of appellees' witnesses that appellant's ore contained abnormal amounts of clay gangue slime which soaked up or absorbed a good part of the oil and made it useless in the process. In fact the actual figures negative the argument here made in appellant's brief.

The illusory figures of appellant's operations are contrasted in appellant's brief (p. 53) with the actual figures of the slide machine tests made by Dr. Chandler in the Hyde case. These tests it may be noted, were not put forward as representing the best practice under the patent in suit, but merely as repetitions of the operations at appellant's mill directed by Hyde. They were part of the evidence of infringement. They show six averaged operations with 3.2 lbs. of oleic acid to the ton of ore, .16% of the ore (Vol. 1, p. 166, Q15). Of this oil 12.7% or .4 lbs. (four-tenths of a pound) to the ton of

ore (p. 161) went to waste in the tailings with .2% of the zinc of the ore (p. 165). But the percentage of oleic acid to the tailings, the figure appellant's brief quotes from appellant's reports and fails to quote from Dr. Chandler's careful and complete tables, was the minute figure of .047%, forty-seven one-thousandths or about five one-hundredths of one per cent.

The actual figures of amounts of original oil found in the concentrates are also instructive and also lead to exactly the opposite conclusion from that asserted in appellant's brief on pages 43 and 53.

During the period, February 4-28, when 20.07 pounds of oil were used per ton of ore treated, 1% of the ore, the concentrates carried 1.86% of oil to concentrates, but this was only 43.8% of the oil used and was only 8.8 lbs. of oil per ton of ore treated or .44% of the ore treated, in fact a small fraction of 1% of the ore treated.

During the period, March 21-31, when 22.86 lbs. of oil were used per ton of ore treated, 1.14% of the ore, the concentrates carried 2.45% of oil to concentrates, but this was only 45.8% of the oil used and was only 10.4 lbs. of oil per ton of ore treated or .52% of the ore treated, in fact a fairly small fraction of 1% of the ore treated.

The joint run of April 29, 1917, was undoubtedly an unusual operation. The low temperature of the water, the floating grease and the discharge to waste of the rich tailings of the second cleaner containing 8.65% of zinc, 173 pounds of zinc to the ton, were all abnormal.

Here the highest percentage of oil appeared in the concentrates, 3.13% of oil to concentrates, which was 54.1% of the oil used and 14.29 lbs. of oil per ton of ore treated and .71% of the ore treated. Thus we find in the concentrates a fairly large proportion of oil to ore treated, but still a fraction of 1% of the ore treated.

All of the above figures are calculated from appellant's reports of tonnage and oil determinations. They all show errors in oil determinations in that the figures do not exactly balance, but this is characteristic of all oil determinations put in evidence by appellant. Probably the soluble frothing agent in the pine oil which goes into solution and stays there helps to explain these errors, and it is also probable that the middlings change their oil content from period to period, and thus vary the total figures which do not discriminate between unused and used oil.

APPELLANT'S BRIEFS IN GENERAL.

Appellant's brief is replete with quoted fragments of the great litigious literature which has been created in the conflicts arising in relation to the invention in suit, and the supplement thereto entitled Plaintiff's Limitations, etc., consists of nothing else except such quotations. The effort has been made to present every statement in testimony and argument in the three litigations in this country which may in any manner when fragmentarily presented create the impression that appellees have asked the courts for a limited construction

of the patent in suit in order that it might be sustained. An example of this is found in appellant's brief at pages 10 to 16. The testimony fragmentarily here presented related to the example of the patent in suit wherein "say from 0.02% to 0.5%" (Spec. p. 1, lines 80, 81) of oleic acid is recommended for use with Broken Hill ore. It so happened that in the Hyde suit and in the Miami suit the total amount of oil used was well within these recommendations, and therefore the only questions at issue in those suits arose out of the use of oil in these minute proportions.

This is followed by quotations from the arguments and briefs of counsel for petitioners-complainants in the Hyde case (appellant's brief, pages 17 to 19) and other quotations are made at pages 33 and 34 of appellant's brief and at pages 139 to 180 of appellant's further brief entitled Plaintiff's Limitations, etc.

The complete and brief argument submitted to the Supreme Court as to what appellant now regards as the crucial point, is not printed in these voluminous excerpts. This was the argument as to claim 9, wherein a question such as has here arisen was to some extent predicted and the court was asked not to prejudge it. Part of this argument appears at page 152 of Plaintiff's Limitations, etc. The other, and what would appear to be the vital part of this argument does not appear, the two fragments at pages 161 and 162 of Plaintiff's Limitations, etc., being altogether incomplete. This part of the argument is reprinted in full herein (*supra*, p. 287, et seq.).

One of the documents quoted in Plaintiff's Limitations, etc., is entitled Printed Oral Arguments on Appeal in this Court. The excerpts appear at pages 133 to 138 of Plaintiff's Limitations, etc. This document was filed by counsel for appellant in the Hyde case without notice to or the knowledge of counsel for appellees therein. The oral arguments were stenographically transcribed and copies sent to counsel for appellees for their corrections, and were exchanged thus corrected with appellant's counsel for the corrected minutes of appellant's counsel, and it was agreed that the corrected minutes were to be filed with the court. In fact, however, appellant's counsel elaborately edited and corrected the stenographer's minutes of their own arguments and printed them with the uncorrected minutes of the arguments of appellees' counsel, and filed them with the court without notice to appellees' counsel. Some two years later, by accident, appellees' counsel received a copy of the printed book which had been thus filed. In so far as it purports to contain the arguments of appellees' counsel it is wholly unreliable, and the quotations which have been made from it are so interspersed with errors that they should be disregarded altogether by this court.

From the corrected stenographer's minutes of the argument of Mr. Williams in this court in the Hyde suit the following may be quoted:

"The specification here [in claims 9, 10 and 11] of the quantity of oil is a small quantity of oil. It may be possible that in the future somebody will use more than a fraction of 1% of oil *and get the new result which was never obtained before we got it*. Such a thing is a pos-

sibility. I take it this court does not have to pass upon that future possibility. * * * These claims specify a small quantity of oil" (p. 65).

"This is a brief statement of the claims in issue which distinguish the invention, because in every claim there is a statement of that new operation which brought out *a new result*—which was never known before,—agitating the mixture to form a froth, agitating the mixture to cause the oil-coated mineral to form a froth, agitating the mixture to form a froth. That was the characteristic, striking, new, useful feature of the invention" (p. 66).

It was also asserted, not only that mineral-froth production was new, but also that no prior art documents disclosed processes whereby mineral-froths could be produced. Appellant's surprising experiments misrepresenting the prior art first exhibited to appellees' counsel at the hearing in this court, called forth some surprised utterances from associate counsel for appellees which may not in themselves have indicated that appellant's products of the legerdemain of the laboratory were not in any manner deemed to represent the actual prior art from which the invention was to be distinguished. But Mr. Williams in his argument had already characterized all of these experiments as follows:

"Appellant takes the refinements of our apparatus and produces laboratory freaks that were never known or heard of or thought of before this invention was discovered" (p. 76).

And as to the appellant's experiment alleged to represent the Froment description:

"Defendant has introduced some new evidence in the form of a procedure which is not in accordance with the Froment description, but inasmuch as it is new evidence, and new evidence cannot be considered at this time here, I do not give it any further attention" (pp. 95, 96).

And as to appellant's experiment alleged to represent Kirby:

"Now, the demonstration which was made in court was not Kirby. It was something which was not known when Kirby filed his application. It was something that was not known to us. This phenomenon of producing a froth with greater quantities of oil by careful laboratory manipulation is a discovery of Dr. Byrnes [appellant's expert] and to him we give the credit for it" (p. 102).

Certainly appellees' position in the argument before this court was the same then as it is now. A broad construction of the patent was asked for and appellant's spurious froths were sufficiently characterized as such and not as prior art.

Dated, San Francisco, March 5, 1918.

Respectfully submitted,

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